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SYSTEM LEVEL WARRANTY LAWS:
THEIR IMPLICATIONS FOR MAJOR USAF
WEAPON SYSTEM ACQUISITIONS

THESIS

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AFIT/GLM/LSP/85S-33

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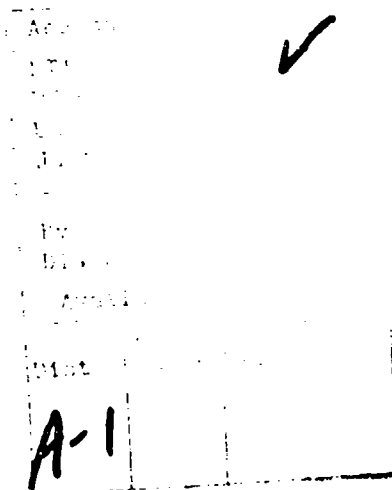
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THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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September 1985

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Preface

The purpose of this study was to determine whether or not Public Law (P.L.) 98-212 and P.L. 98-525 would improve the quality of major USAF weapon system acquisitions.

The authors selected this topic since it was current, dynamic, and had implications for their professional careers in USAF contracting and program management.

We would like to thank all those middle/senior level managers in DOD/USAF and industry (from contracting, program management, engineering, legal, and cost-analysis) who let us interview them. Though our nonattribution policy does not permit specific listing of these sources we would like to thank them in aggregate. We also thank our thesis advisor and reader Dr. Melvin Wiviott and Dr. John Garrett who shared good advice and helped us keep the scope of the topic to manageable proportions.

The authors would especially like to thank their wives. Though our research took a great deal of time from our home lives, they provided us with a great deal of encouragement and moral support.

Richard J. Hernandez

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Abstract

The issue of poor weapon system quality has recently received much media and Congressional attention. Part of the reaction to the problem of poor quality with some systems was the enactment of Public Laws (P.L. 98-212 and P.L. 98-525) requiring warranties for DOD weapon systems. This thesis examined whether or not system level warranty laws would improve the quality of major USAF weapon system acquisitions.

To keep the scope manageable, the authors focused only on major USAF weapon systems with a total acquisition value over \$1 billion that were in full scale production and were under a fixed price type contract. Our basic research consisted of a literature review to gather data on warranties under the old and new laws and then to compare field practices under the old and new warranty laws. To get information on prior and current field practices we interviewed middle and top managers from Government and industry on a time available basis.

After conducting our research and analyzing our data the authors arrived at the major conclusion: the system level warranty law will not substantially improve the quality of major USAF weapon system acquisitions since the USAF acquisition and logistics infrastructure is geared to components and not systems. Other factors impeding the effective implementation of the law are: a poor warranty data base, no real structured way to perform warranty cost-benefit analyses, unclear

definition of weapon system, and the lack of effectiveness of the USAF warranty focal point i.e. the Product Performance Agreement Center (PPAC).

Our major recommendation is the USAF should give PPAC the necessary authority and resources to carry out its assigned mission of helping the USAF acquisition community with warranties. The USAF should also develop qualitative and quantitative warranty decision models to help analyze warranty cost-effectiveness and field personnel should be trained in their use.

SYSTEM LEVEL WARRANTY LAWS:
THEIR IMPLICATIONS FOR MAJOR USAF
WEAPON SYSTEM ACQUISITIONS

I. INTRODUCTION

Purpose Statement

The purpose of this thesis is to determine if system level warranty laws will improve the quality of major weapon systems purchased by the United States Air Force. For the purpose of this thesis, component and lower-level item warranties will only be discussed as they relate to system level warranties.

Introduction

Warranties are a common feature of many commercial items such as automobiles, stereos, home computers, televisions, refrigerators, and air conditioners. Warranties have also been used by the Department of Defense (DOD). According to Mary Ann Gilleece, Deputy Under Secretary of Defense (Acquisition Management), the use of warranties, by the DOD is not new. One-third of DOD's 4.1 million items are covered by some form of warranty. Usually this is a standard commercial warranty. In 1967, DOD expanded its warranty coverage with the use of a "correction of deficiency" clause. Gilleece emphasizes there is an important difference between the DOD and commercial warranties. Since 1971 it has been DOD policy to "act as a self-insurer for loss of or damage to property of the government occurring after final acceptance of

supplies delivered to the government and resulting from any defects or deficiencies in such supplies" (11:25). This policy has been supported and reinforced by Congress (11:25).

DOD's policy of being a self-insurer has resulted in increased amounts of money being expended by DOD in an attempt to correct some well-publicized problems with weapon systems. The following problems serve as examples:

a. The Army's "superweapon" M-1 Abrams tank has a super sleek design, state-of-the-art electronics and an engine that tends to jam (22:26).

b. Microcircuit chips used in many key frontline U.S. weapons are found to be faulty (24:26).

c. The Pershing II, surface-to-surface missile, has not performed well in test firings due to quality problems (17:83).

d. The AGM-65D Infrared Maverick, the AIM-54C Improved Phoenix, and the tube-launched, optically tracked, wire-guided (TOW) missiles are reported to have "serious deficiencies in quality control and workmanship" (25:24). Air Force findings reveal the quality problems "are systemic throughout the TOW, Phoenix, and Maverick programs and directly affect the integrity of products delivered to the military" (25:24).

e. The AWG-9, APG-65, and APG-83 radar units used on the Navy F-14, F-18, and USAF F-15 fighters respectively are experiencing quality control and workmanship problems (25:24).

General Issue

The general issue raised by the poor state of quality with some weapon systems is the public perception DOD is inefficient with its resources and is either unable or unwilling to make its contractors perform. The above examples create and/or reinforce a public perception DOD is buying weapons that are fantastically expensive, yet do not always work as expected. The U.S. public deserves the best possible value for its defense dollars. The DOD must work to insure it meets this expectation.

Overall Management Question

The overall management question posed by major weapon system acquisitions: is how does the DOD, and in particular the U.S. Air Force, get good quality products at a fair and reasonable price?

Specific Problem Statement

The specific research question involved in the above management issue is to determine whether or not poor quality in major USAF weapon systems can be improved by the use of system level warranties.

Definition of Key Concepts/Terms

Before beginning an in-depth discussion of warranties it is essential to clarify key concepts and terms for two important reasons. First, many of the terms relating to warranties for major weapon systems may be unfamiliar to the average reader. The second reason

clarification is required is due to the complexity of the concepts and terms associated with major weapon system warranties. To prevent any misunderstandings of meanings, key terms relating to warranties are defined. It is essential one understand these terms before continuing.

The formal definition of warranty provided by Frederick Biedenweg in Warranty Policies: Consumer Value vs. Manufacturer Costs states:

A warranty is a contractual obligation incurred by a manufacturer or vendor in connection with the sale of an item or service. The warranty specifies that the manufacturer agrees to remedy certain defects or failure in the commodity sold. The purpose of the warranty is to promote sales by assuring the quality of the items or service to the customer.

There are many different types of warranties but most seem to fall into one of two categories as defined by the Federal Trade Commission. These two categories are the "full warranty" and the "limited warranty." A full warranty specifies that the product must be repaired or replaced within a reasonable time at no charge to the customer. In a limited warranty the consumer is frequently expected to pay at least a portion of the cost of repairing or replacing the product. (3:1)

Other applicable definitions follow:

"Weapon System" is equipment that is or can be used directly by armed forces to carry out combat missions. (28:4)

"Procurement" is the prime contract between the government and contractor for production of a weapon system and/or component. Research and development is excluded unless it provides for production. (28:4) Note: the terms acquisitions and procurement are used interchangeably in this thesis.

"Component" is an assembly or any combination of parts, subassemblies, and assemblies mounted together in manufacture, assembly, maintenance, or rebuild. Spare parts, per se, are not deemed components. (23:2)

"Specified Performance Requirement" is any specifically delineated mandatory performance requirement set forth anywhere in a government production contract for a weapon system or in any other agreement relating to the production of such system incorporated or referenced in such contract. (23:2)

"Conform" means designed and manufactured so as to meet or achieve, or both, the government's specified performance requirement. (23:2)

"At no cost to the government" means the costs will not be reimbursed to the contractor directly or indirectly under the production contract for the weapon system or any other government contract (except for the firm fixed price guarantee line item). (23:2)

"Quality" is the composite of material attributes including performance features and characteristics of a product or service to satisfy a given need. (20:563)

"Quality Control (QC)" is all actions directly related to measuring conformance of the items, including surveillance of the production process and assessing the changes thereto, for the purposes of detecting and preventing defects. (20:564)

"Request for Proposal" is the solicited model contract between the Air Force and the contractor on a contemplated procurement. It is the medium by which a contractor is introduced to the job desired by conveying a complete understanding of the work to be performed and to determine the capability and price of the contractor's efforts. RFP's contain language, terms, and conditions necessary to obtain information from prospective bidders. (20:587)

"Reliability" is the probability a system, subsystem, component, or part will perform a required function under specified period of time. (20:576)

"Prime Contractor" is an individual, partnership, company, corporation, or association who enters into an agreement with the Government to perform work or furnish supplies. (20:538)

"Subcontractor" is any supplier, distributor, vendor or firm which furnishes supplies or services to or from a prime contractor or another subcontractor. (20:664)

The above definitions (as opposed to any other interpretations) will serve as a common meaning throughout the remainder of this thesis.

In the next section the authors will discuss, in a general context, the overall state of U.S. industrial quality.

Background

General Quality Problems

A review of current literature reveals the DOD product quality problems are a subset of the overall U.S. quality problem. The problem is universal. General Lou Allen, retired USAF Chief of Staff, as quoted by Air Force magazine, summarized the severity of the nation's quality problem.

One of the causes for the cracks in the nation's defense industrial base is the growing impression in this country that we can't build things right any more, whether it's automobiles or F-15's. The media (are) filled with stories of cost overruns, schedule slippages, computers that don't work and sophisticated weapons of questionable reliability and supportability. To the degree that we in the military ... and industry have have a hand in creating this impression of incompetence, it's up to us to change it. (26:100)

General Slay, former commander of Air Force Systems Command, expresses similar concerns to those of General Allen. General Slay notes other industrialized countries like those in Europe and especially in Japan have very often surpassed the United States in terms of industrial efficiency and quality. A key factor behind declining U.S. productivity is poor quality which he describes as a "national disease" (20:101).

Another high-ranking officer, General Thomas Marsh, former AFSC commander, noted "the Japanese firms build quality into the product while U.S. firms try to inspect it in" (16:109).

The costs of poor quality to the Department of Defense are tremendous. Aviation Week & Space Technology provides an overall assessment of these costs:

The cost of correcting defects in our weapons and equipment runs in the range of 10-30% of the total (budget). This represents enormous waste -- billions of dollars when the overall budget is considered. (18:109)

Other disadvantages associated with poor quality are as follows:

- a. Dissatisfied customers
- b. Reputation of being a poor-quality producer
- c. Shrinking markets
- d. Product liability suits
- e. Product recall programs
- f. Governmental sanctions (9:673)

There are many reasons contributing to the decline of quality in the U.S. industry. Some of the major reasons are summarized below:

- a. Lack of concentration on resources for basic design.
- b. Insufficient cooperation between government and industry in defense contracts.
- c. Inadequate worker training.
- d. Destabilizing year-to-year incremental program funding.
- e. Excessive government specifications.
- f. Complex hardware/software designs.
- g. Premature introduction of new systems.
- h. No capacity for incremental growth of systems.
- i. Deficiencies in defining requirements.
- j. No feedback to contractors on performance of field equipment.
- k. Difficulties/costs associated with designing quality control processes.
- l. Insufficient top management emphasis on quality. (18:109-113)

As the above discussion indicates there appear to be serious problems with the state of industrial quality in the United States. The remainder of the introduction will discuss arguments both for and against a warranty as a way to correct the quality problem. The focus of our discussion on warranties as a partial cure for quality problems is on USAF major system acquisitions.

DOD Pro/Cons

Arguments on Behalf of a Warranty

The problem of product quality has major consequences for the DOD. First and foremost, the quality of weapon systems directly affects the ability of our forces to win on the battlefield. Our armed forces must, in many cases, stake their very lives on the quality of their weapons. The second consequence is the fact DOD has only a finite amount of resources and poor quality just squanders them. The third consequence is DOD can ill afford the public perception it cannot or does not want to control its contractors and/or get what it pays for.

As a part of public reaction to DOD quality problems a new systems level warranty law was enacted (13:11). Public Law (P.L.) 98-212, Section 794, known as the Andrews Amendment, requires warranty provisions for workmanship, materials, and performance. The law became effective March 14, 1984 (15:5). The law is also known as the "Weapon System Warranty Act" (4:4). The requirements of P.L. 98-212 Section 794 are summarized in the August 1984 issue of Contract Management magazine:

This guaranty contains two distinct types of contractor warranties, both of which will be included in appropriate contracts: 1) a warranty that the weapon system and each (significant) component thereof were designed and manufactured so as to conform to the government's specified performance requirements and 2) a warranty that, at the time of delivery to the government, the weapon system and each (significant) component thereof are free from such defects in materials and workmanship as would cause the system or component to fail to conform to the government's specified performance requirements. (15:6)

The warranty requirement is not binding in all cases under the Andrews Amendment; in fact, the Secretary of Defense has the discretion to waive the requirement for reasons of either national security or excessive costs. However each waiver must be explained to Congress (6).

The August 1984 issue of Contract Management, the magazine of the National Contract Management Association, provides the following interpretation of when the Andrews Amendment is applicable:

1. The law is now interpreted to apply only to prime contractors.
2. The law does not apply to cost-type contracts but rather to firm fixed priced contracts for mature weapon systems in production.
3. The law only applies to major weapon systems or their significant elements. Note for the purposes of the new law such items as software, ordinance, ground handling equipment, training devices, or test equipment may not be included "unless an effective guaranty for the weapon system would require the inclusion of such items."
4. Research and development contracts are not subject to the new law.
5. Contracts and contract modifications awarded after March 14, 1984 will be subject to the new law.
6. To date foreign military sales have not been excluded from the warranty requirement. (15:6-7)

The warranty requirements imposed by P.L. 98-212 have generated much controversy within public, DOD, Congressional, and industrial circles. The implications of P.L. 98-212 promise to be far-reaching with effects ranging from the health of the defense industrial base to the state of our force readiness. Depending on who you talk to, the new warranty law is either a badly needed reform or another example of government over-regulation of industry.

The overall rationale for the new warranty law is to insure taxpayers get the most for their money. Fortune magazine describes this sentiment as:

Andrews and his allies acknowledge that warranties might result in higher front-end costs. But they think spending a bit more to ensure a satisfactory system saves big money in the long run.

Says an Andrews aide: "Our objective is to make sure the weapon works right the first time. If it doesn't, the manufacturer has to fix it, and the taxpayer stops footing the bill." (5:143)

Senator Andrews uses the derivative fighter aircraft engine as an example where cost savings to the taxpayer were realized through warranties. Andrews notes "... the Air Force has stated potential life-cycle savings of some \$2 billion due to warranties on the durability of key engine parts" (2:1). Senator Andrews has been the champion of weapon system warranties and was the key force behind the enactment of P.L. 98-212. The Senator's overall rationale is, "to assure weapons work as intended" (2:1).

Senator Andrews argues the following positive aspects of the warranty law:

1. The manufacturer is held accountable for defects.
2. Competition will be increased.
3. The defense industrial base will be strengthened.
4. The situation between prime and subcontractors will improve. Warranty experience can be passed from the prime to the subcontractor. The specialization of subcontractors will allow them to efficiently back a warranty.
5. The warranty law is enforceable, even in overseas operating locations.
6. The warranty law should not impact existing contracts or those in negotiation.
7. Technological innovation will be enhanced. Warranties will increase innovation as they have in the commercial sector, competition between manufacturer warranties will lower prices and improve performance. State-of-the-art technology has been successfully warranted. Examples are NATO satellites and the Space Shuttle orbiters.
8. Cost-effectiveness of warranties can be estimated with mathematical models. (2:4-5)

In an effort to amplify the above aspects of P.L. 98-212, the authors interviewed Mr. John Metzger, defense analyst for Senator Andrews, and discussed the subject of the new warranty law. Mr. Metzger indicated a key factor in the warranty law was to get dependability upfront. He stressed weapon systems must be reliable to prevent loss of life to our military personnel. Mr. Metzger noted weapon system warranties have been successfully used abroad for many years. He stated many French weapon systems have warranties which do work and insure the French taxpayer receives a quality product although he could not name any specific programs (21).

The authors note P.L. 98-212 has been subsequently modified by P.L. 98-525; however, its basic thrust remains essentially intact. The new law is not without controversy and there are arguments against its use.

Arguments Against a Warranty

Critics of the Andrews Amendment allege the law is part of a "steadily marching trend toward greater micromanagement in the military acquisition process" (13:11). An editorial in the 2 April 1984 issue of Aviation Week & Space Technology, "A Prescription For Chaos," seems to represent a cross section of aerospace industry opinion. Some of the problems cited are:

1. The military procurement process will be interrupted since the terms and conditions of the law are not specific.
2. Small contractors, due to the cost of backing up a warranty, could be forced out of the defense business. Prime contractors may be reluctant to sign new contracts.
3. The law will force prime contractors to make components themselves. This means lost business to small contractors.
4. The differences between the commercial and military operating environments make warranties impractical for weapons.
5. The law does not specify how long a warranty should apply. An open-ended liability for a contractor could present an unacceptable risk. (12:9)

Probably the most important problem cited by critics with the new warranty law is increased costs. Critics argue warranties will increase major weapon system acquisition costs. Defense 84 points out "For the contractor there is pricing risk because of competitive pressures, optimistic reliability and maintainability estimates, unforeseen

operational stresses, and mishandling that may occur in the field" (11:26). The article continues by stating: "Without exception, warranties and product performance agreements and guarantees cost money, whether it is explicitly identified or whether it is included in the total price of the end item" (11:26).

Summary of Introduction

Component and lower level item warranties have traditionally been the mainstay of DOD warranties. Due to public perceptions of DOD mismanagement as publicized by problems with several major weapon systems, a new systems level warranty law (P.L. 98-212) was passed by the Congress. The new systems level warranty law poses a new challenge to DOD.

The essential question posed by this thesis is whether or not the system level warranty law will improve the quality of major USAF weapon system acquisitions. Toward this end, the authors feel warranty use must be balanced between protecting public interest, cost effectiveness, and military utility. These needs must be reconciled for an effective combination.

The systems level warranty question is a complicated one. At issue are the health of the U.S. defense industrial base, the proper role of Congressional and other oversight agencies involvement in military procurement, U.S. force readiness, public confidence in DOD, the possibility of increased weapon systems costs, and the implications of trying to administer the new law. To help keep the research problem to

manageable proportions, the authors have devised a research approach that specifically focuses on the problem at hand. The methodology is discussed in detail in the next chapter.

II. RESEARCH METHODOLOGY

Overview of Chapter

This chapter discusses the research objectives, population of interest, method of exploration, research techniques, and investigative questions used in answering the question of whether or not system level warranties will improve the quality of major USAF weapon system acquisitions. In addition the authors will provide a recommended way of implementing the new warranty law within the USAF.

Research Objective

The purpose of this thesis is to conduct exploratory research and forecast the effectiveness of systems level warranty laws (P.L. 98-212 and P.L. 98-525) on improving the quality of major USAF weapon system acquisitions.

Description of the Population of Interest

The scope of this thesis is limited to major USAF weapon system warranties purchased under fixed price contracts. Cost type contracts are not included since they do not fall under the act. The scope is also limited to weapon systems with a total acquisition value of over \$1 billion.

There are three additional reasons the population was narrowed to contracts and programs with a total acquisition value over \$1 billion. First, the specifications contained in fixed priced contracts are usually more definitive than cost type contracts and lend themselves to a clearer interpretation and identification of contractual requirements and responsibilities. As Principles of Contract Pricing states contractual requirements in cost type contracts are usually stated as goals as opposed to firm requirements in fixed priced contracts. Cost type contracts use goals because they are mainly used during research and development and the USAF usually cannot define state-of-the-art technology to a sufficient degree that would allow the contract to succeed. In the opposite case, fixed priced contracts are usually used when the specifications are well developed, the item has been proven to meet specifications, and a stable design exists (1:102). Given a clear understanding of fixed priced contractual requirements, it is easier to identify the contractor's specific responsibilities. The second reason the population was narrowed concerns cost identification. In cost type contracts, warranty costs can be "comingled" by contractors with other costs and this makes it difficult and/or impossible to identify them to their applicable contracts. Thus the true cost of warranties can't be identified (27:440). In fixed price contracts all costs, including the warranty, can usually be explicitly identified. The third reason for narrowing the population concerns dollar thresholds. The time limitations imposed on the authors to accomplish this thesis further limited the scope to only major USAF weapon system programs i.e. those over \$1 billion.

The overall rationale for limiting the scope was to allow for a better evaluation of the system level warranty. The authors felt, given the nature of fixed priced contracts i.e. firm requirements and the the \$1 billion threshold, as described above, helped provide for a much better population to study and analyze system level warranties.

Method of Exploration and Research Techniques

The method of exploration and research was accomplished in three stages. The first stage was to perform an indepth study to develop the authors' knowledge of warranties and to determine the effectiveness of warranty provisions prior to the enactment of P.L. 98-212. The second stage was a review of the current structure and requirements of the system level warranty law. This stage also examined how the current laws are being implemented and administered in the USAF acquisition and support environments with a comparison to the warranty provisions prior to P.L. 98-212. The third stage reviewed, analyzed, and compared the results from the first two stages and forecasted how the system level warranty law would affect major USAF weapon system quality.

Stage I Review of Laws and Practices Prior to P.L. 98-212

The first stage consisted of a survey of published literature on weapon system contract warranties prior to the enactment of P.L. 98-212. The purpose of the literature review was to obtain a better understanding of the effectiveness of the prior warranty provisions and to turn up leads for further investigation to advance/facilitate our research. Another part of this stage reviewed practices prior to P.L.

98-212 and P.L. 98-525. As part of our research, we conducted a survey of executive opinion among knowledgeable DOD/USAF contracting and program management personnel to assess the prior laws and practices prior to P.L. 98-212. The authors also interviewed knowledgeable contractor personnel.

Stage II Review of Requirements/Implementation of P.L. 98-212

The second exploration stage consisted of a literature review from the time P.L. 98-212 was enacted to the present with a specific emphasis on the structure/requirements of the public law. Similar to stage I, interviews were held with a cross section of knowledgeable DOD/USAF contracting and program management personnel. Contractor personnel were also interviewed to determine if their opinions varied from those of the government. Note: for the purposes of economy and efficiency the authors conducted their interviews with major DOD firms asking stage I and II questions together and concentrated among the top defense firms.

Given the heavy concentration of DOD procurement resources to a relatively few firms (only 20 programs now consume over 40 percent of the DOD's procurement dollars each year) (10:32). The authors feel a good sample was obtained by researching among a subset of this population. The focus will be from a sampling of those firms supplying major USAF weapon systems. We interviewed approximately 100 people from both the DOD/USAF acquisition community and key personnel in top defense firms. Our interviews with DOD/USAF people were from the following disciplines: contracting, program management, logistics, engineering, and legal. Military people interviewed were mainly major through

colonel. Government civilians interviewed were in the GS-12 through GM-15 grades. In addition we interviewed a Congressional aide. In a similar fashion, our interviews with contractors were conducted with their contracting, pricing, and legal people. Contractor personnel interviewed, like their DOD/USAF counterparts, were also senior and middle managers. Most of the people we talked to had a minimum of 10 years experience in the weapon system acquisition business and were either in charge of their respective department or held a key position in that department.

In the Air Force interviews were conducted with contracting and program management personnel in both the Air Force Systems Command (AFSC) and the Air Force Logistics Command (AFLC). As a subset of this group, interviews were conducted with selected individuals in Aeronautical Systems Division, Air Force Contract Management Division, Air Logistics Centers, and selected Air Force Plant Representative Offices. Since this subject has received much interest in the U.S. Congress, interviews were conducted with this source as well.

Stage III Comparison and Forecast

The third and last stage consisted of a comparative review of the first and second stages. Specifically we compared the old and new laws to determine their differences and similarities. Having compared the new and old laws the authors forecasted the effects of the systems level warranty law on major USAF weapon system quality. The forecast included a discussion on whether or not the new law can be effectively administered, achieve cost effectiveness, and advance/improve weapon

system quality. The authors also provided their recommendations on how to make the new systems level warranty law more effective.

Investigative Questions

Investigative questions were divided into three general groups of interest. First, a generic set of questions was used to obtain the individual's overall general understanding and feeling/ideas about warranties. The second group of questions was intended to gather information about warranties used prior to P.L. 98-212. The third set of questions was used to gather specific information about system level warranties. These questions were used as a guide to structure our interviews as we conducted our exploratory research. The questions are listed below:

Group I Questions (General Knowledge)

1. What is a major weapon system warranty?
2. What elements make a warranty effective and why?
3. What aspects of a major weapon system should a warranty cover and why?
4. What aspects of a major weapon system should not be covered by a warranty and why?
5. What determines how long a warranty should last and why?
6. When is a warranty realistic for a new USAF weapon system?
7. Is there a difference between military and commercial warranties? If so, what is it and why is there a difference?
8. From your experience, does the USAF use realistic warranty requirements i.e. mean time between failure rates, stress rates, heat/cold standards, etc.?

9. Do warranties discourage contractors from bidding on USAF contracts? If yes, why?
10. What are the costs associated with warranties?
11. What are the best type of warranties for major weapon systems?
12. Should weapon system warranties contain priced options for extended warranties?
13. What is the best method to determine liability for deficiencies? Please consider cost and be realistic.

Group II Questions (Knowledge of laws/practices prior to P.L. 98-212)

1. Are you familiar with the warranty provisions used when the USAF contracted under the Armed Services Procurement Regulation (ASPR) and/or the Defense Acquisition Regulation (DAR)?
2. If the answer to the above question is yes then did the warranty provisions contained in the ASPR and/or DAR provide incentives for contractors to meet contract terms and requirements?
3. Do you feel the ASPR and DAR warranty provisions were effective in making sure the USAF received quality products?
4. Was it possible to determine liability under these provisions? Please explain your answer.
5. What were the most effective warranties under the ASPR and DAR?
6. What elements of the major weapon system were covered under these warranties?

Group III Questions (Knowledge of System Level Warranties)

1. What is your perceived impact of the new public law requirement for warranties in all major USAF weapon system contracts?
2. Will there be an increased cost for system level warranties?
3. If the answer to the above question is yes then what is your best estimate of the warranty cost as a percentage of major weapon system unit cost? Please provide an estimate for items in consecutive production runs.

4. Do you feel the system level warranties will be worth the costs associated with them?
5. Has the system level warranty law changed your method of pricing warranties? If so, how?
6. Will contractors provide products of better quality as a result of the system level warranty law? Please explain your answer.
7. Do contractors identify unreasonable specifications to the government and if so do they ask they be removed and/or corrected?
8. Are there advantages for contractors not to bring unreasonable specifications to the Government's attention? If yes, what are they?
9. Is there a maximum price for system level warranties e.g. 20% of unit price?

Procedures Used to Analyze Data

When both the interviews and literature reviews were completed the authors analyzed and edited the data. This was done to insure the data met the following criteria:

1. Accurate
2. Consistent with other data
3. Uniformly entered
4. Complete
5. Ready for tabulation
6. Arranged

During the editing process errors or omissions in the interviews were identified and corrected by follow-up interviews with respondents for necessary correction and/or clarification. This was done to insure accurate understanding and reporting of the opinions of those interviewed. The period of our study was from June 1984 to August 1985, inclusive.

As a means to obtain candid and sincere information from the persons interviewed we decided to use a nonattribution policy whereby specific organizations and/or individuals were not identified. Due to the widespread media and Congressional attention, a nonattribution policy was felt to be the only way to get honest opinions from vulnerable government and contractor executives.

III. LAWS AND PRACTICES PRIOR TO P.L. 98-212

Overview of Chapter

In this chapter we discuss the laws and practices pertaining to the use of major weapon system warranties prior to the enactment of the system level warranty law. The prior laws and practices were examined from the standpoint of their effectiveness in achieving improved quality for major USAF weapon systems. We discuss our findings under the old laws and practices. In addition we discussed problems encountered under the old laws and how they related to the systems level warranty law.

Prior Laws and Regulations

Our discussion of prior laws centers on two sets of regulations. The first is the Armed Services Procurement Regulation (ASPR). The second set is the Defense Acquisition Regulation (DAR). Note the Federal Acquisition Regulation (FAR) replaced the DAR in 1984. For the purposes of the discussion on in this chapter the FAR is not applicable. The FAR and its relation to the systems level warranty law will be discussed in the following chapters.

The ASPR was the DOD's "basic statement of procurement policy for military departments" (20:66). The ASPR provided for the following types of warranties: warranty of supplies for complex and non-complex items, correction of deficiencies, and warranty of services

(29:144-150). The ASPR served as the basic DOD procurement policy guide for many years but it was eventually replaced by the DAR in the 1970s. The ASPR clauses and provisions carried over to the DAR.

Like the ASPR the DAR provided for "uniform policies for the Departments of the Army, Navy, and Air Force relating to the procurement of supplies and services under the authority of Title 10, United States Code, Chapter 137" (20:66).

An Air Command and Staff College research report on Air Force Management of Warranties lists and defines the five types of warranties available for procurement application under the ASPR and DAR:

1. Reliability improvement warranty (RIW) (formerly referred to as a "failure free" warranty) is the latest type to be implemented in the DOD. An RIW is defined as a provision in either a fixed price equipment overhaul contract in which for a fixed additional price:
The contractor agrees for a specified or measured period of use, he will repair or replace (within a specified turnaround time) all equipment that fails (subject to specified exclusions if applicable); and
The contractor is provided with the monetary incentive, throughout the period of the warranty, to enhance the production design and engineering of the equipment so as to improve the field/operational reliability and maintainability of the system/equipment, thus reducing the required number of repairs.
2. Correction of Deficiencies Clause - Under this type of warranty, the contractor agrees to correct any design, material, or workmanship deficiencies which result in the specific item performing below specification and contractual requirements. Such clauses in Air Force Systems Command weapon systems and government furnished aerospace equipment contracts usually apply to spare parts, aerospace ground equipment and any other supplies included in the contract.
3. Supply Warranty - Under this warranty, the contractor is responsible to replace or rework contract items if defects or nonconformance in design (if applicable), material or workmanship are found prior to the expiration of a specified period of time or

before occurrence of a specific event. Normally, there should be no significant increase in item price for this kind of warranty. It should be quite feasible to make a positive determination that a defect existed at the time of acceptance if it is found when the item is drawn from supply for initial use. However, it will be more difficult to determine a defect existed at the time of original acceptance if the item has been installed and operating for some appreciable period of service and is then found defective.

4. Service Warranty - Under such a warranty, the contractor agrees to correct defective services providing defects of nonconformance in design (if applicable) and workmanship are found prior to the expiration of a specified period of time or before the occurrence of a specific event.
5. Commercial Warranties - These are similar to supply and services warranties except the contractor determines responsibility.
(8:4-5)

Of the five types of warranties listed above the authors found the correction of deficiency and reliability improvement warranty were the most commonly used in relation to weapon systems. Our research found the COD clause was the most predominantly used form of warranty under the old laws and regulations. The COD clause coupled with a clear specification and a positive government/contractor relationship allowed for a far-reaching catch all remedy to correct deficiencies. Interviews with government executives indicated the RIW was the second most preferred type of warranty. Government executives preferred the RIW since it was easy to administer i.e. allowed for a minimal conflict between the government and contractor as to liability, the costs were identified upfront (no unprogrammed costs), and focused on components rather than systems. Contractors liked the RIW since it was essentially a sole source contract. It was also learned from government sources that RIWs were a way for contractors to correct deficiencies at the government's expense. Due to poor government tracking and processing of

claims contractors often escaped responsibility for defects. In conjunction contractors received additional cost benefits due to few government claims being filed.

Differences Between Old and New Warranty Laws/Regulations

As illustrated above neither ASPR nor DAR provided for "weapon system" warranties in the sense required by P.L. 98-212. The focus under ASPR and DAR was on component warranties. In that a system is the sum of its components, one could say the weapon system was warranted by many component warranties. By contrast the new public law requires a weapon system warranty covering all components.

The component warranties, provided for under ASPR and DAR, were not without problems. It is important the reader understand the problems encountered with component warranties because these same problems may be applicable to the systems level warranty law. Since a law is only as good as its enforcement we will look at how the prior warranty laws and regulations were administered by DOD/USAF field personnel and what type of problems were encountered.

Practices Prior to P.L. 98-212

Our discussion of the practices prior to P.L. 98-212 originates mainly from our field interviews and literature review. Specific sources from our field interviews are not identified in accordance with our stated nonattribution policy. We interviewed approximately 100 people from both the DOD/USAF acquisition community and key personnel in

top defense firms. The specific sources are not identified because of the sensitive nature of the questions asked. However our interviews with DOD/USAF people were from the following disciplines: contracting, program management, logistics, engineering, and legal. Military people interviewed were mainly Major through Colonel. Government civilians interviewed were in the GS-12 through GM-15 grades. In addition we interviewed a Congressional aide. In a similar fashion, our interviews with contractors were conducted with their contracting, pricing, and legal people. Contractor personnel interviewed, like their DOD/USAF counterparts, were also senior and middle managers. Most of the people we talked to had a minimum of 10 years experience in the weapon system acquisition business and were either in charge of their respective departments or held a key position in that department. The results of our interviews are reported in an aggregate opinion fashion. Our research revealed the following information on prior practices:

a. The DOD was a self-insurer of its own systems. Overall it was felt this was more cost-effective than paying the contractor for a warranty or similar form of insurance.

b. DOD relied mainly on implied versus explicit warranties. Warranties were based on the goodwill between the contractor and government. Contractor goodwill was important since a bad product would make for a poor reputation and the possibility of lost future DOD/USAF business; the opposite was true for good products. It was therefore mutually beneficial to the contractor and the government to insure quality products were provided.

c. Warranties prior to P.L. 98-212 mainly focused on components. Program and implementation strategies as well as contractual instruments were all geared to this philosophy.

d. The COD clause was the predominant form of warranty found during our research. The COD focused mainly on materials and workmanship. Performance per se was not warranted.

e. Most programs did not tailor warranties to their specific needs. Rather they simply pulled the standard provisions from the ASPR and DAR and inserted them into their respective contracts. The same ASPR and DAR warranty provisions were inserted verbatim year after year from one contract to the next. Our research revealed no unique and/or tailored warranty clauses.

f. Guidelines for administering and preparing major weapon system contract warranties were few and far between. Guidance even for component warranties was vague. For example the ASPR and DAR mention one should consider the following factors when using warranties:

1. Nature of Item
2. Cost
3. Administration
4. Trade Practice. (29:1:55-1:56)

However the guidelines were too vague for contracting officers and administrators to follow. In most cases, we found the individual program was for the most part on its own when it came to preparing and administering warranties.

g. Our research revealed little early on work between the key offices i.e. SPOs, AFPROs, ALCs, and using commands as far as how warranties would be structured and administered.

h. Neither field nor policy making persons interviewed were able to tell us how they performed warranty cost-benefit analysis. We found no structured methodology on how to perform warranty cost-benefit and/or (technical) tradeoff analysis.

i. In conjunction with the lack of a structured method to perform a cost-benefit analysis we found the requisite historical reliability and maintainability (R&M) data base is severely deficient to nonexistent in the field. Many government programs/buying offices were not purchasing the type of data required to structure a good warranty on the same or similar type items in the future. When the required R&M data was being collected it was not being consolidated for future warranty use i.e. pricing, administration, and identifying essential performance features. Overall we found many program offices did not get the type of data required to structure a good warranty until it was too late and too often not at all.

j. As part of the warranty data problem, weapon system testing appeared to be inadequate for the purposes of obtaining good R&M data from which to structure a warranty. Testing for warranty purposes received a low priority compared to other program elements. Insufficient collection and analysis of test data contributed toward the problem of a poor data base on which to develop future warranties.

k. Steady and rapid turnover of key program management and contracting personnel in a variety of programs has weakened the historical data base (corporate memory) and thereby hurt program continuity. This impacts the overall program to include the corporate memory required to structure and administer good warranties.

1. Overall we found little real emphasis on warranties. The main emphasis found was on cost, schedule, and performance with support related elements taking a back seat i.e. warranties. The authors observed a lack of proactive warranty planning for follow-on buys of current and similar systems. We felt there was a lack of aggressiveness on the part of those responsible for implementing warranties. There was a lack of communication between those who wrote the warranty laws/regulations and those required to implement them. In general we felt field personnel interviewed had a very indifferent attitude about warranties.

The authors are not alone in our findings on prior laws and practices. In a 1979 study presented to the U.S. House of Representatives Committee on Appropriations on DOD use of warranties the Surveys and Investigations Staff reported similar findings. As the staff noted "at least nine other reviews had been conducted on DOD's use of warranties by agencies such as General Accounting Office (GAO), Army and Air Force Audit, Defense Audit Service, and the Ratio Technical Commission for Aeronautics (RTCA)" (30:11). The studies indicated problems in five major areas:

1. lack of visibility over the cost or use of warranties at headquarters level;

2. lack of information at the user level on the existence of warranties on the items covered;
3. inadequate information regarding warranty terms and corrective procedures;
4. complicated and time consuming procedures needed to obtain warranty service; and
5. warranty expiration during extended storage or shipping time. (30:11)

Air Force Management of Warranties has similar findings to those mentioned above. Specifically mentioned problems are listed below in quotes/paraphrases:

1. Basic policy and procedures for warranty administration exist within the Air Force although weaknesses are present. The major problem stems from vague guidance as to when warranties should be used, and from failure to comply with existing procedures. (8:4)
2. Warranties for items shipped overseas must be weighed against their cost to return/repair them at the manufacturer's facility. This is often not done. (8:5)
3. There is an inadequate warranty data base. The Air Force has warranty guidelines but without data and administrative procedures to make them meaningful the warranty will continue to be misused and confused. Continued warranty use under these conditions is ineffective. (8:7)
4. There is no single individual or activity charged with overall surveillance of warranty programs. Improper application of prescribed procedures was a major factor in the ineffective use of warranties. (8:10)
5. Current Government regulations and procedures for the procurement and administration of warranties do not provide for efficient and effective application and enforcement of warranty provisions. (8:11)
6. Overall problems noted by the study are: lack of knowledge by those responsible for implementing procedures, vague guidance, lack of compliance with established procedures, and a perception warranties are not worth the time, effort, and expense. (8:11i)

Issues Concerning Prior Laws and Practices

Our research indicated the prior provisions worked well when a good government and contractor relationship existed and the contractor's concern for his/her corporate goodwill was paramount. However the overreliance on unstructured and implied warranties was not without consequences as some well-publicized cases have succinctly demonstrated. Weapon system horror stories such as the all too limited C-5A wing life, Maverick missiles not being able to hit their targets, overpriced spare parts, unrealistic testing conditions, and engines on the M-1 tank jamming from dust. These and similar incidents created and/or reinforced a public perception the DOD procurement process was inherently flawed. Worse yet the public perceived the DOD's will to enforce its contractual provisions was mediocre at best. A key factor bringing public attention on weapon system acquisition was their dramatically escalating costs. A major factor focusing attention on DOD acquisitions problems was the emphasis on readiness in that the U.S. military relies on the quality of its weapon systems to offset the quantitative advantage enjoyed by the Soviets. Reduced U.S. weapon system quality threatens to invalidate this whole premise of quality over quantity. The July 1985 issue of Air Force magazine notes the Soviets are not only ahead of the U.S. quantitatively but are also aggressively making progress in closing the qualitative gap (31:95). As part of the result of the increasing public attention and growing perception of DOD mismanagement coupled with the growing Soviet threat, the new systems level warranty law was enacted by Congress.

After P.L. 98-212 was enacted we asked all surveyed government field personnel what they felt was the best way to make warranties effective. A consensus of government field opinions indicated the best combination of the prior laws and practices was the use of the COD clause and a good weapon system specification. It was felt this combination provided a principal contracting officer with a far-reaching remedy to correct defects.

However the authors note a potential problem in developing excessive specifications. Often the government develops too many detailed, overlapping, and conflicting specifications and as a result the weapon system complexity increases accordingly. Increased complexity leads to increased costs and difficulty with administering and enforcing warranties. If warranties are inadequate, then the quality may be inadequate and failures may occur. Failures receive bad press which lower public confidence in the DOD weapon system acquisition process. Lower confidence prompts Congress to pass more laws that require excessive specifications and management controls. Thus Congress assumes more of a micromanagement versus macromanagement role and the cycle repeats itself potentially aggravating the problem further.

To the authors an effective warranty needs to be balanced against risk and cost. Technical and administrative risks need to be balanced with the level of technical expertise being sought and the administrative burden required from both the government and contractor standpoint. A review of warranty costs should also consider insurance costs.

Chapter Summary

The key laws and regulations used to guide warranty use prior to P.L. 98-212 were the ASPR and the DAR. The Federal Acquisition Regulation replaced the DAR in 1984 and discussion on it (as it relates to warranties) has been reserved for the next chapter. This chapter presented the five basic warranties available during the pre-P.L. 98-212 period. The author's research found the COD and RIW the most predominately used under ASPR and DAR. Having presented what was used prior to the new law, the authors presented the key difference between the old and new warranties. The key difference being components, under the old laws and regulations, as opposed to warranting the entire system under the new law.

The authors provided examples of problems encountered with the old laws and regulations and the results of their field interviews. The field interviews found some very obvious problems which had been raised in several other previous investigative/analytical reports and on which very little progress had been made. Those problems included: a poor data base upon which to draw from, write, and cost analyze future warranties; a lack of communication between the key players in developing and administering warranties; no central focal point for managing warranties or consolidating data; excessive specifications which complicated DOD and other warranty enforcement; and little real emphasis on warranties.

IV. REQUIREMENTS OF P.L. 98-212 AND P.L. 98-525

Overview of Chapter

In this chapter we will discuss the requirements of the systems level warranty law (P.L. 98-212) and its subsequent modification (P.L. 98-525). The systems level warranty laws will be examined from the standpoint of their legal requirements. As part of the discussion on the new laws the authors will discuss the laws and their relation to the Federal Acquisition Regulation (FAR). A comparison of the warranty provisions in ASPR and DAR to those of the FAR and P.L. 98-212/525 will also be presented.

Federal Acquisition Regulation Warranty Requirements

The FAR is now the principal acquisition regulation used by USAF contracting personnel at all levels. Field personnel use the FAR for guidance and direction in structuring warranty provisions for contracts. The new warranty law requires contracting officers to have written warranties in weapon system contracts. In that regard one would be remiss not to discuss the systems level warranty law and its relation to the FAR. To understand the impact of the systems level warranty law on the FAR it is essential the reader first understand the FAR warranty requirements. Once the FAR warranty requirements are understood they will then be compared to the new public laws.

The FAR became effective 1 April 1984 (33:4). Contract

Management magazine defines the Federal Acquisition Regulation as:

one, governmentwide acquisition regulation that contains acquisition policies, procedures, contract clauses, and forms relating to all federal government agencies. It is neither a new set of regulations, nor is it more regulations. Rather, it is a consolidation and simplification of the regulations of the DAR, the NASA PR, and the GSA FPR. (33:4)

The Air Force Institute of Technology text Government Contract

Law explains the purpose of the FAR.

It precludes agency acquisition regulations that unnecessarily repeat, paraphrase, or otherwise restate the FAR and it limit agency acquisition regulations to those necessary to implement FAR policies and procedures within an agency. The FAR provides for coordination, simplicity, and uniformity in the Federal acquisition process. The FAR includes changes recommended by the Commission on Government Procurement, the Federal Paperwork Commission, various Congressional groups, and others. It also provides for agency and public participation in developing the FAR and agency acquisition regulations. (36:1-11)

The DAR, NASA Procurement Regulation, and the GSA Federal Procurement Regulation will still be used until all contracts written in accordance with them are eventually closed out. As Contract Management notes "In a few cases, this might be 10 to 20 years" (33:4).

Our specific discussion of FAR warranty guidance and provisions is limited to the following areas:

- a. General discussion
- b. Criteria for the use of warranties
- c. Authority for use of warranties
- d. Limitations on warranty use

e. Warranty terms and conditions

Each area is discussed in the following paragraphs.

General discussion. To begin with, the FAR defines a warranty as "a promise or affirmation given by a contractor to the Government regarding the nature, usefulness, or condition of the supplies or performance of services furnished under the contract" (34:46-9). The FAR notes a warranty should specify both Government and contractor rights and obligations in case items/services are defective. The warranty should also foster quality performance (34:46-9). According to the FAR a warranty should provide for these general items:

- (1) A contractual right for the correction of defects notwithstanding any other requirement of the contract pertaining to acceptance of the supplies or services by the Government; and
- (2) A stated period of time or use, or the occurrence of a specified event, after acceptance by the Government to assert a contractual right for the correction of defects. (34:46-9)

Criteria for the use of warranties. Like the ASPK and DAR, the FAR recommends a contracting officer consider the following factors in deciding whether a warranty is appropriate:

(a) Nature and use of the supplies or services. This includes factors such as:

- (1) Complexity and function;
- (2) Degree of development;
- (3) State of the art;

- (4) End use;
 - (5) Difficulty in detecting defects before acceptance; and
 - (6) Potential harm to the Government if the item is defective.
- (b) Costs arising from:
- (1) Contractor's charge for accepting the deferred liability;
and
 - (2) Government warranty administration and enforcement
- (c) Administration and enforcement must consider:
- (1) Nature and complexity of item;
 - (2) Location and proposed use of the item;
 - (3) Storage time for the item;
 - (4) Distance of the using activity from the source of the item;
 - (5) Difficulty in establishing existence of defects; and
 - (6) Difficulty in tracing responsibility for defects.
- (d) Trade practice i.e. is a warranty normally included in the item price. (34:46-9)

Authority for use of warranties. The FAR states "use of a warranty in an acquisition shall be approved in accordance with agency procedures" (34:46-9). Note: the new public law no longer allows agencies the discretion to decide if warranties will be used for weapon systems. The law dictates the use of explicit written warranties in weapon system contracts. Specific requirements of the law will be discussed later in this chapter.

Limitations on warranty use. The FAR notes contracting officers shall not use warranties for cost-reimbursement contracts, unless approved by agency regulations (34:46-9).

Warranty terms and conditions. The FAR requires contracting officers to make sure warranties clearly state the following areas:

- (1) Exact nature of the item and its components and characteristics that the contractor warrants;
- (2) Extent of the contractor's warranty including all of the contractor's obligations to the Government for breach of warranty;
- (3) Specific remedies available to the Government; and
- (4) Scope and duration of the warranty. (34:46-10)

The four areas listed above are key to successful enforcement of warranties. These areas are key because they make it possible to identify who has responsibility for correcting defects and therefore promotes effective enforcement.

The FAR makes the salient point that a warranty is only as good as its enforcement. Specifically the FAR says "The Government's ability to enforce the warranty is essential to the effectiveness of any warranty" (34:46-9). FAR continues its discussion on warranty administration by saying "There must be some assurance that an adequate administrative system for reporting defects exists or can be established" (34:46-9). Warranty administration is a vital point which will be discussed in detail later.

The 1 April 84 FAR states warranty use is not mandatory (34:46-9). This is no longer true due to the enactment and requirements of P.L. 98-212 and P.L. 98-525.

Requirements of Public Law 98-212

In this section we will discuss the requirements of P.L. 98-212 and interpretations of its key sections. Before discussing P.L. 98-212 in detail it is important to briefly clarify the rationale for its enactment. As the 14 May 1984 issue of Fortune magazine notes Senator Andrews felt if people could get warranties on their TV sets, washing machines, and air conditioners then the Pentagon should be able to get warranties on its weapon systems. In fact the Senator's tractor came with a warranty (5:143). These arguments are popular, easily understood, have a common sense appeal, and were highly publicized by the media. Consequently the law was passed. The appropriateness of analogies between commercial items and weapon systems will be discussed in subsequent chapters.

The actual law is very short, in fact it is only one page. Public Law 98-212, Section 794 is provided below:

Sec. 794.(a) Except as otherwise provided in this section, none of the funds appropriated by this or any other Act may be obligated or expended for the procurement of a weapon system unless the prime contractor or other contractors for such system provides the United States with written guarantees--

(1) that the system and each component thereof were designed and manufactured so as to conform to the Government's performance requirements as specifically delineated (A) in the production contract, or (B) in any other agreement relating to the production of such system entered into by the United States and the contractor.

(2) that the system and each component thereof, at the time they are provided to the United States, are free from all defects (in materials and workmanship) which would cause the system to fail to conform to the Government's performance requirements as specifically delineated (A) in the production contract, or (B) in any other agreement relating to the production of such system entered into by the United States and the contractor, and

(3) that, in the event of a failure of the weapon system or a component to meet the conditions specified in clauses (1) and (2)--

(A) the contractor will bear the cost of all work promptly to repair or replace such parts as are necessary to achieve the required performance requirements; or

(B) if the contractor fails to repair or replace such parts promptly, as determined by the Secretary of Defense, the contractor will pay the costs incurred by the United States in procuring such parts from another source.

(b) A written guarantee provided pursuant to subsection (A) shall not apply in the case of any weapon system or component thereof which has been furnished by the Government to a contractor.

(c) The Secretary of Defense may waive the requirements of subsection (a) in the case of weapon system if the Secretary--

(1) determines that the waiver is necessary in the interest of the national defense or would not be cost-effective; and

(2) notifies the Committees on Armed Services and Appropriation of the Senate and House and Representatives in writing of his intention to waive such requirements with respect to such weapon system and includes in the notice an explanation of the reasons for the waiver.

(d) The requirements for written guarantees provided in subsection (a) hereof shall apply only to contracts which are awarded after the date of enactment of this Act and shall not cover combat damage. (32)

The key features of P.L. 98-212 are its emphasis on warranting the entire weapon system, its emphasis on having the prime contractor correct defects, and its specific emphasis on warranting performance.

The overall law requires (weapon) system level warranties for performance, materials, and workmanship. This is quite a change from the ASPR, DAR, and FAR provisions, discussed previously, which primarily focused on warranties for component material and workmanship. P.L. 98-212 specifically identifies the prime contractor, as opposed to the subcontractors, as having overall responsibility for correcting weapon system defects. This is a significant change from the ASPR and DAR where defective components were corrected by the individual vendor. DAR and FAR warranty provisions were examined for compliance with the statutory requirements of the new law by the Air Force System Command Staff Judge Advocate. In their legal opinion, dated 22 March 1984, the Director of the Contract Law Division stated in summary "none of the five clauses reviewed comply with all statutory requirements and OSD/AF guidance as is, but all could be made to comply with appropriate add-on paragraphs" (19:2). The clauses examined were: DAR 7-105.7b, DAR 7-105.7c, FAR 52.246-18, FAR 52.246-19, and the OSD model clause (19). The last key feature of P.L. 98-212 is its specific emphasis on warranting weapon system performance. Under the ASPR, DAR, and FAR only performance and workmanship were warranted and then only at the component level versus the systems level. P.L. 98-212 encompasses several other aspects.

The other aspects of P.L. 98-212 involve the remedies for corrections, exemptions, and waivers to the law. The remedies for correction are essentially for the prime contractor to replace or repair defective parts or if the prime cannot do so then the prime must pay someone else to repair/replace. Exceptions to P.L. 98-212 only occur

for those weapon systems or components furnished to the prime contractor by the Government. Waiver authority can only be obtained under two conditions. First the warranty must be determined not to be cost effective and both the House and Senate Armed Services and Appropriations Committees must be notified.

The new public law left some areas unaddressed and thus caused some confusion. Some of these concerns were addressed during the annual Boeing Principal/Corporate Administrative Contracting Officer conference held on 24 October 1984 at Cape Kennedy, Florida are summarized below:

1. How does one determine the duration of the guarantee? How does one tailor the guarantee clause to their program?
2. How does one determine if performance requirements are realistic and achievable in accurately reflecting the needs of the weapon system? How does one identify the appropriate components of the weapon system for applicability of a written guarantee?
3. How is consequential and third party damage covered/excluded?
4. Who assumes liability for transportation costs to and from the repair facility?
5. How does one determine equitable adjustment for defective items?
6. How does one determine the cost-effectiveness of the guarantee? That is how does one determine if the price for the guarantee is beneficial to the government? (14)

Based on these and other concerns, P.L. 98-212 was updated. The updated law is discussed below.

Requirements of Public Law 98-525

Public law 98-525 was passed 19 October 1984 as part of the fiscal year 1985 appropriations act (28). Based on our research there appears

to be little difference between P.L. 98-212 and P.L. 98-525 except the latter is more specific as to when the systems level warranty applies and when Congress is to be notified of waivers. The following is a general comparison of the two public laws; the details of their differences will be discussed in subsequent paragraphs. Warranties are still required on a system level for performance, materials and workmanship under both laws. Both emphasize the prime contractor is to correct defects or pay another for their correction. Weapon system performance under P.L. 98-525 is still explicitly warranted. The remedies against the contractor are essentially the same but have been made more flexible under P.L. 98-525. Both P.L. 98-212 and P.L. 98-525 do not require guarantees for weapon systems or components that are government furnished; however, the latter allows for tailoring in this area. Rules for waivers to the law are also similar. In short there is little difference between P.L. 98-212 and P.L. 525 except P.L. 98-525 did refine and narrow the scope of P.L. 98-212 and redefined some key terms.

P.L. 98-525 modified several important definitions pertaining to the systems level warranty. For example essential performance requirement is now defined as "the operating capabilities or maintenance and reliability characteristics that the Secretary of Defense determines are necessary for the system to fulfill the military requirement for which it is designed" (35:34). A component is defined as "any constituent element of a weapon system" (35:34). A mature, full-scale production weapon system means "the manufacture of all units of a weapon system after the manufacture of the first one-tenth of the eventual

total production or the initial production quantity of such systems, whichever is less" (35:34). This definition of mature, full-scale production allows the services to use their discretion in warranting the first one-tenth of the initial production quantity being purchased. The authors feel a more crucial aspect of P.L. 98-525 was the change in the definition for a weapon system.

Weapon system was redefined as "Equipment that can be used directly by armed forces to carry out combat missions \$100,000 per unit cost or \$10,000,000 total procurement cost. Excludes commercial items" (28). P.L. 98-525 expanded warranty coverage to include design and manufacturing conformity. The addition of a design and manufacturing warranty was in addition to the warranties for materials and workmanship and essential performance conformity required by P.L. 98-212 (28). The scope of an essential performance requirement for a weapon system is now narrowed to systems in mature, full-scale production. Essential performance requirements can be tailored; however, Congress must be notified if essential performance warranty requirements are not included in the contract for a weapon system not in full-scale production (28). Like its predecessor, P.L. 98-525 does not require a warranty for a weapon system or component that has been furnished by the Government. The law does allow for tailoring in this area (28). Waiver authority between the two laws is similar with P.L. 98-525 imposing more specific requirements. For example P.L. 98-525 requires the Congress be notified 30 days in advance of waiver approval. In addition if an essential performance requirement warranty is omitted from a weapon system contract not in full-scale production Congress must be notified (28).

An important point about P.L. 98-525 was raised in the 7 July 85 issue of Federal Contracts Report is the "DOD may use written guarantees to a greater extent than required under the statute and may impose broader requirements or more comprehensive remedies" (35:34). The warranty requirement still extends to the prime contractor whom the law defines as the one who "enters into an agreement directly with the United States to furnish part or all of a weapon system" (35:34).

Overall Comparison of P.L. 98-212/525 to Prior Warranty Laws

As we can see the systems level warranty laws emphasize written warranties for: design and manufacturing, essential performance requirements, and materials and workmanship. Under the new law the whole system is warranted by one contractor (the prime) as opposed to each of the system's many components being warranted by many individual contractors as done under ASPR, DAR, and FAR. In addition design and manufacturing and essential performance requirements are now warranted. Overall P.L. 98-525 corrected weaknesses and confusions raised by P.L. 98-212.

The authors use the following chart provided by Headquarters AFSC (Contract Policy) to summarize and compare the laws.

Comparison of Warranty Laws

<u>Item</u>	<u>Section 794 of '84 Appropriations</u>	<u>Section 2403 of '85 Authorizations</u>
Application	All production	Option - may exempt initial production from performance warranty
Dollar Threshold	None	Applies to Programs with total cost exceeding \$10M or with a unit cost exceeding \$100K.
Remedy for Defect	Manufacturer Repairs	Manufacturer may repair or replace or reimburse Gov't for repair or re- placement at Gov't election.
Material/Workmanship Warranty	Required	Required
Performance Warranty	Required for all mandatory performance requirements	Required for defined essential performance requirements
Design/manufacturing Warranty	Not applicable	Required for all items
Congressional Notification of waivers	Required for each waiver	Required for all major programs - all others consolidated (28)

Chapter Summary

In this chapter we presented the requirements of P.L. 98-212 as modified by P.L. 98-525. Before delving into the new system level warranty laws we discussed the FAR requirements and provisions prior to the new laws and showed the previous provisions did not satisfy the statutory requirements in the public laws. The FAR requires some

updating in light of the new laws in that it has been used for component instead of system level warranties. We have explained the principal differences between the two laws were definitive in nature in that P.L. 98-525 narrowed and clarified the requirements of P.L. 98-212. The major definitive changes were the definitions for weapon system and mature, full-scale production. As we can see P.L. 98-212 and P.L. 98-525 are essentially similar except the latter is more specific. It is important to note "weapon systems warranties are statutorily based and thus are required to be included in contracts covered by the Weapon System Warranty Act - i.e. DOD contracting activities do not have discretion to include or exclude warranties in particular circumstances" (4:2).

In the next chapter we will discuss the Air Force efforts to implement the system level warranty law.

V. DOD/USAF DIRECTIVES IMPLEMENTING THE SYSTEMS LEVEL WARRANTY LAW

Overview of Chapter

In the previous chapter we discussed the requirements of the system level warranty laws. This chapter discusses the formal direction given to DOD/USAF for the implementation of the systems level warranty law. Implementation will be examined from the standpoint of DOD/USAF direction and procedures. To give the reader a complete understanding of the implementing directives the authors have chosen to use extensive quotes and paraphrases from these directives as well as from other authoratative sources.

USAF Implementation Direction

In this section we will discuss the formal direction given to USAF field personnel to implement the systems level warranty law. Our review found numerous implementing directives to each of the various organizational levels. Rather than report on each one we have decided to focus on the three key implementing directives. Our discussion of these directives follows their chronological order of issuance. The following directives to be discussed are the: Air Force Acquisition Circular (AFAC) 84-10, the Defense Acquisition Circular (DAC) 84-9, and the proposed USAF FAR supplement implementing AFAC 84-10/DAC 84-9. Before discussing the implementing directives in detail the authors feel it is appropriate to provide a short narrative on how these directives

originate and what authority they carry.

The origins of the directives started with enactment of the system level warranty law. As we understand the process in this case the law was then reviewed by the FAR Committee and found to be applicable only for DOD since they are the only Federal agency that buys weapon systems. It then became incumbent upon the DAR Council to review its responsibilities to satisfy the law. From this point the procedure for implementation passes on to the individual service. HQ USAF/RDC, the Director of Contracting and Manufacturing Policy, is charged with Air Force implementation of the new law. Our analysis focuses on the Air Force implementation.

Each directive has an order of precedence. Public laws have precedence over all directives. Directives from the FAR Committee have priority over those from the DOD. DOD directives have priority over those of the individual services. However the order of precedence and issuance do not always coincide. Such is the case with the implementing directives on the system level warranty law. In this particular instance the AFAC 84-10 (covering USAF warranty implementation) was issued before the DAC 84-9 (which covered DOD warranty implementation).

The Three Key DOD/USAF Implementing Directives

Air Force Acquisition Circular 84-10

The AFAC 84-10 was issued 28 December 1984 and became effective 2 January 1985. AFAC 84-10 remained effective until replaced by the

Defense Acquisition Circular 84-9 (7). AFAC 84-10 has two parts: the interim DAR Council policy guidance on major weapon system warranties as required by P.L. 98-525 Section 2403 and provided guidance in the form of an interim DOD FAR Supplement (DFARS) Subpart 46.7. The rationale for incorporating the DFARS in AFAC 84-10 is the "Air Force felt that guidance was required immediately by the field due to the effectivity date of the of law" (28). Discussion of the major parts of AFAC 84-10 relating to major weapon system acquisition are discussed in the following paragraphs.

The first major part of AFAC 84-10 is the DAR Council policy guidance on weapon system warranties which became effective 2 January 1985. Our discussion of the DAR Council guidance is divided into the following four areas: definition of contract award, solicitation implementation guidance, request for waivers, and AFAC 84-10 discussion on DAC 84-9.

Definition of Contract Award. AFAC 84-10 defines what does and does not constitute a new contract award because only new contracts are covered by the new law. The DAR Council implementation guidance in AFAC 84-10 states the following constitute contract awards:

- (1) new contracts;
- (2) a modification to a contract to add additional quantities;
- (3) the placement of an order under a basic ordering agreement or basic ordering agreement;
- (4) the definitization of a letter contract that includes a clause requiring definitization in accordance with law and regulations in effect at time of definitization; and

- (5) definitization of options containing not-to-exceed prices.
(7:B-1)

The DAR Council, recognizing compliance could not possibly be retroactive to all situations, states the following do not constitute new contract awards and therefore are not required to comply with AFAC 84-10:

- (1) the exercise of a priced production option where no further definition or negotiation of terms is required;
- (2) the notice to proceed with quantities after the first year quantity in a multi-year procurement;
- (3) the definitization of an existing redeterminable contract; and
- (4) a contract for long-lead which covers only preparatory work, and does not itself call for delivery of end items. A contract which subsequently incorporates long lead effort does not meet the criteria for application of this guidance. (7:B-1)

Solicitation Implementation Guidance. The DAR Council guidance recognized some weapon system contracts, at the time when AFAC 84-10 was issued, had not yet been awarded and consequently issued the following direction to include them. For contracts awarded after 1 January 1985 the following guidance applies:

- (a) for source selection where negotiations have been completed, commands must reopen negotiations to include the required warranty provisions either definitively priced or under a not-to-exceed (NTE) to be negotiated within some specified period.
- (b) for source selections where negotiations have not yet begun, solicitation amendments must be issued to incorporate warranty provisions.
- (c) for sole source procurements, commands must reopen negotiations to include required warranty provisions either definitively priced or as NTE.

(d) if field activities determine that incorporation of the warranty provisions prior to award would cause substantial delay in that contract award, a waiver may be processed in the interest of the national defense. Every effort should be made to comply with the guidance. Use of waivers and savings clauses must be kept to a minimum. Inclusion of a savings provisions in a contract will require approval of a waiver. (7:B-2)

Request for Waivers. Waivers to the weapon system level warranty law must be submitted along with the appropriate justification to AF/RDC. The DAR Council lists the following as minimum requirements for a waiver request:

- (a) description of the system.
- (b) waiver requested, and its duration if it extends beyond the instant procurement.
- (c) rationale for the waiver.
- (d) warranty to be included in lieu of the required warranty.
- (e) actions taken to preclude waivers on future procurements. (7:B-2)

Waiver guidance also states "Contract award will not be made until the waiver is approved and congressional notification is complete (when required)" (7:B-2).

AFAC 84-10 Discussion on DAC 84-9. The DAR Council states "DAC 84-9 provides a completely new Subpart 46.7 of the DFARS which requires that each weapon system contract contain three specific warranties, one covering design and manufacturing requirements, one covering defects in materials and workmanship, and one covering essential performance requirements delineated in the contract" (7:B-3). DAC 84-9 also provides for tailoring of warranties, ways to obtain waivers, and

direction on establishing: essential performance requirements, warranties and foreign military sales, and warranty cost benefit analysis (7:B-3). The DAR Council guidance notes AFAC 84-10 will be replaced by DAC 84-9 however due to time considerations they are "issuing DAC 84-9 in its present form" i.e. as it appears in AFAC 84-10 (7:B-3). However DAC 84-9, like AFAC 84-10, will only be temporary (7:B-4).

While the first part of AFAC 84-10 discussed the DAR Council guidance the second part of AFAC 84-10 contains the DOD FAR Supplement (DFARS) guidance on Subpart 46.7 i.e. for warranties. DFARS makes the point warranty planning needs to be done early, warranties may be included as part of an item's price or priced as a separate contract line item, and requires field agencies to track and accumulate data relative to warranty costs (7:B-5). The DFARS continues by stating warranties for major weapon systems will be done in accordance with P.L. 98-525 and with regard to warranty use limitations the DFARS states "Except for contracts for the production of weapon systems under 47.770, contracting officers shall not include warranties in cost reimbursement contracts" (7:B-5,6). DFARS requires warranted items be marked in accordance with Military Standard (MIL-STD) 129 and MIL-STD 130 and requires warranties on technical data where it is practical and cost effective (7:B-7). DFARS also reaffirms the definitions of key terms used in P.L. 98-525 i.e. "design and manufacturing requirements", "essential performance requirements", "prime contractor", and the like. However the definition of a weapon system i.e. "a system or major subsystem used directly by the armed forces to carry out combat

missions" requires special attention since the DFARS expands on this definition (7:B-8). The DFARS guidance on weapon system definition is provided below:

By way of illustration, the term "weapon system" includes but is not limited to the following, if intended for use in carrying out combat missions; tracked and wheeled combat vehicles; self-propelled, towed and fixed guns, howitzers and mortars; helicopters; naval vessels; bomber, fighter, reconnaissance and electronic warfare aircraft; strategic and tactical missiles including launching systems; guided munitions; military surveillance, command control, and communication systems; military cargo vehicles and aircraft; mines, torpedoes; fire control systems; propulsion systems; electronic warfare systems; and safety and survival systems. This term does not include related support equipment, such as ground handling equipment, training devices and accessories thereto; or ammunition, unless an effective warranty for the weapon system would require inclusion of such items. (7:B-9)

DFARS policy requires a weapon system cost threshold of more than \$100,000 unit cost or more than \$10,000,000 for total procurement cost for the warranty to be required. This policy also requires these thresholds apply to production efforts occurring after 1 January 1985 (7:B-9). Specific policy provisions parallel those required by P.L. 98-525 in that they require the same type of warranties i.e. for performance, materials and workmanship, and design and manufacturing.

DFARS allows a contracting officer (CO) some discretion when it comes to tailoring system level warranties. A CO may narrow the scope of the warranty as well as limiting the contractor's liability. The reason for the tailoring is to insure cost effectiveness (7:B-10).

DFARS states "essential performance requirements" be established by the Secretary of Defense or heads of military department, or delegates (7:B-11).

DFAFRS does not require prime contractors to warrant government furnished property (GFP) unless the following conditions occur: defective installation, installation or modification in a way that invalidates a manufacturer's warranty, or modifications made to the GFP by the prime contractor (7:B-11).

DFARS notes it is DOD policy "to only obtain warranties that are cost effective" (7:B-12). In that regard DFARS requires an analysis be done of warranty costs i.e. acquisition and administration. DFARS recommends life cycle costing techniques and comparisons to similar systems to help with the analysis. DFARS recommends the analysis be documented in the contract file (7:B-12).

DFARS also requires each Military Department to "issue procedures for processing waivers, notifications, and reports to Congress" (7:B-14). Each waiver request must contain the following: description of the system, waiver requested (and its duration beyond if it is beyond the instant procurement), rationale, warranty substitute, and actions to prelude use of future waivers (28). A written record must be kept of each waiver and a copy of the Congressional notification must be submitted concurrently to the Under Secretary of Defense (Research and Engineering) (7:B-14).

Defense Acquisition Circular 84-9

As previously mentioned AFAC 84-10 was issued prior to DAC 84-9. The reason AFAC 84-10 was issued before the DAC instead of afterwards as one would normally expect (i.e. concerning precedence) involved timing.

An AFAC can be issued very quickly compared to a DAC where the former may take weeks and the latter may take months. Because top policy makers felt guidance on systems level warranties was needed right away the AFAC was issued. Based on our review the AFAC 84-10 (dated 28 December 1984) guidance on Subpart 46.7 is essentially the same as the DAC 84-9. Though dated 2 January 1985, DAC 84-9 did not reach the field until March/April 1985. In fact all the wording in DAC 84-9 is for the most part verbatim from AFAC 84-10. To preclude redundancy we will not discuss the DFARS guidance again. Suffice it to say they are the same.

Proposed USAF FAR Supplement Implementing AFAC 84-10 and DAC 84-9

At the time of this writing the proposed USAF FAR Supplement for AFAC 84-10 and DAC 84-9 is in draft form. The USAF FAR Supplement was to be released during the summer of 1985; however, this has not occurred due to the many Congressional and Defense Industry comments on the draft document. The exact release date is unknown. However we can discuss some of its key features.

First of all "A team approach is suggested for developing warranty strategy which includes acquiring, administering, and enforcing" (28). The team approach basically involves including all the acquisition related disciplines in warranty planning to include: program management, engineering, logistics, budget, contract, pricing, and weapon system users. Warranty strategy is to be formally documented in two plans. One plan will be for acquisition and the other plan will be for administration and enforcement (28).

Second, contracting officers are now required by the USAF Supplement implementing AFAC 84-10/DAC 84-9 to keep closer watch on warranty costs with periodic reporting as well as documenting the warranty cost-benefit analysis. Contractors must justify any "over and above costs" for warranties (28).

Third, warranty terms and conditions concerning essential (government) performance requirements will now be covered by one of the conditions or a combination thereof listed below:

(1) Where the performance requirement is deemed to have been met upon satisfactory completion of a specified test or demonstration, in the event the item fails to pass the test or demonstration, the contractor shall at no additional cost to the Government perform all design and manufacture work necessary to conform to the contract requirements and repair or replace the defective items as necessary.

(2) Where the performance requirement consists of operating an item without designated failures or within certain failure rates for a specified period the warranty shall provide that in the event the item fails, the contractor shall at no additional cost to the Government perform all design and manufacture work necessary for the item to conform to the contract requirements and repair or replace such defective items as may be necessary. (28)

The fourth area to be discussed under the USAF FAR Supplement implementing AFAC 84-10/DAC 84-9 was warranty tailoring regarding exclusions, limitations, and scope. Exclusions have the effect of relieving a contractor from "liability for correcting specified defects" (28). Under the new guidance "Contracting Officers shall not agree with any exclusion unless the relationship between the excluded defect and contract requirements is beyond the reasonable control of and not attributable to any fault of the contractor" (28). The next area under tailoring concerns limitations which serve to limit the contractor's

liability. Under the new guidance contracting officers will not be able to agree to any limitations hindering important Government goals (28). Lastly, the scope of the new guidance requires "When a cost type production contract is used to acquire a weapon system, contracting officers should defer obtaining a warranty on essential performance requirements until a fixed-price production contract is used" (28). Our discussion of the new guidance is based on the current draft, however; the reader should be aware the guidance is in draft form and is subject to change.

Chapter Summary

In this chapter we examined the DOD/USAF implementation direction/guidance with respect to the systems level warranty law.

Formal implementation direction is contained in three key documents: the AFAC 84-10, DAC 84-9, and the proposed USAF FAR Supplement Implementation for AFAC 84-10/DAC 84-9. The authors consider these three documents to be key because AFAC 84-10 and DAC 84-9 are most predominately used by field activities and they consolidate all previous guidance. The proposed USAF FAR Supplement implementing AFAC 84-10/DAC 84-9 continues with this consolidated guidance further narrowing it for USAF use.

The AFAC 84-10 contained DAR Council guidance with respect to contract definition, solicitation implementation, waivers, and discussion of DAC 84-9. AFAC 84-10 also contained the DOD FAR Supplement Subpart 46.7. This subpart was issued separately as DAC 84-9 and appears to be

identical to the previous one in AFAC 84-10. The proposed USAF FAR Supplement is in draft form.

Since a law and/or regulation is only as good as its enforcement the authors obtained data on how field personnel were actually implementing the systems level warranty law. Accordingly the next chapter will discuss our findings concerning implementation practices.

VI. USAF SYSTEMS LEVEL WARRANTY LAW IMPLEMENTATION PRACTICES

Overview of Chapter

This chapter discusses the USAF implementation practices and administration of the systems level warranty law. Implementation and administration is examined from the standpoint of actual field practices observed by the authors.

USAF Implementation Practices

Our discussion on current implementation practices of the systems level warranty law originate mainly from field interviews. We interviewed approximately 100 people from both the DOD/USAF acquisition community and key personnel in top defense firms. The specific sources are not identified because of the sensitive nature of the questions asked. However our interviews with DOD/USAF people were from the following disciplines: contracting, program management, logistics, engineering, and legal. Military people interviewed were mainly major through colonel. Government civilians interviewed were in the GS-12 through GM-15 grades. In addition we interviewed a Congressional aide. In a similar fashion, our interviews with contractors were conducted with their contracting, pricing, and legal people. Contractor personnel interviewed, like their DOD/USAF counterparts, were also senior and middle managers. Most of the people we talked to had a minimum of 10 years experience in the weapon system acquisition business and were

either in charge of their respective department or held a key position in that department.

For the purposes of this chapter, the results of our interviews are reported in an aggregate opinion fashion. Our research revealed the following information on current systems level warranty law implementation practices:

Findings on USAF Implementation

Determining Warranty Cost Effectiveness

Though both the system level warranty law as well as implementing directives (AFAC 84-10 and DAC 84-9) require it, USAF field personnel are for the most part unable to determine the cost effectiveness of a systems level warranty. Upper and middle management people were unable to perform a cost-benefit analysis for a weapon system warranty. USAF people did not know what type of approach/structure to use for a warranty cost-benefit analysis. Instead the USAF people we interviewed relied heavily on the contractor to price the warranty and then analyzed the contractor's methodology instead of preparing an independent estimate for comparison purposes. This is a potentially serious problem since the heart of determining warranty cost effectiveness and affordability should be the cost-benefit analysis, which from our research was not being accomplished independently.

In conjunction with not knowing how to approach the structuring of a warranty cost-benefit analysis, field personnel also had problems

pricing, i.e. estimating, the cost of the warranty for negotiation purposes. What causes/compounds the problem is trying to determine the benefits of the warranty. The benefit of a warranty is very intangible and hard to assess a dollar figure to. As a result most people reported they didn't try. The problems of estimating cost and benefit were further compounded by the limited historical data available on which to base a warranty when accomplished for a new weapon system. With more mature systems, i.e. those in later production runs, warranty cost estimating was easier e.g. the C-130 aircraft. However the problem of estimating warranty benefits was still apparent. Another part of the problem complicating the ability of estimating warranty cost effectiveness is the Government's inability to estimate warranty administration costs. These costs are indeed very real and have the potential of being quite significant, yet we found very little consolidated historical data available on warranty administration costs. We saw no structured approach on how to estimate administration costs or historical data being gathered to do so.

Only in one instance did we see a structured approach to warranty costing. In this case the methodology was being used by a major defense contractor manufacturing fighter aircraft. The contractor felt his warranty costing approach was a competitive tool and was reluctant to release too much information. However he did tell us the warranty cost model considered recurring and nonrecurring costs, retrofit costs, and kit installation costs. The model used standard statistical regression methods and was able to show warranty costs as a percentage of unit cost. The model was able to show warranty costs over a range of

aircraft produced. Since this particular weapon system had been in production for a number of years the contractor had adequate data on which to base a sound warranty cost model.

Warranty Data Base

As previously mentioned the authors feel the key to an effective warranty management and administration program is the establishment and maintenance of a good historical warranty data base. A good warranty data base allows the USAF acquisition personnel to conduct meaningful studies of warranty benefits and tradeoffs. The DOD and USAF have recognized this and now require their acquisition personnel to maintain this data as stated in AFAC 84-10 and DAC 84-9. Of the nine major weapon system programs we studied, our research indicated there was much room for improvement in this area. None of the programs studied required the contractor to specifically maintain warranty cost and/or repair data. We did not find a contract with a separate line item requiring this data in any of the programs we studied. In addition, the government was not keeping warranty data for future use. We saw no central focus for warranty data at any of the USAF plant representative offices nor at the systems program office. There was no centralized accumulation of warranty data from the various weapon systems.

There did not appear to be any type of feedback mechanism, either formal or informal, to get field performance data back from the users to the buying activities so warranty requirements and/or costs could be updated in subsequent contracts. The warranty and repair data available to field personnel was not in a form that permitted easy interpretation

and/or tracking since this data was not summarized but rather came in the form of detailed and voluminous output. Though a computerized warranty data base and tracking system offers many benefits, we did not see any such system in operation or plans to get one on line. As it was, most of the data reduction/analysis was done manually if at all.

Warranty Testing

There appears to be no specific emphasis on warranty testing. We saw no specific test plans designed to develop warranty data. We feel this is a potentially serious problem since testing allows a better estimate of how the system operates and establishes a better data base on how to price a warranty. The data gained from such testing increases both the government and contractor knowledge base. Knowledge of a system reduces the risk and this helps reduce the cost; in this case the USAF gets a better deal on the warranty. Most of the USAF people we talked with said they would rely on the data from the weapon system's full scale development to help them estimate warranty costs; this was preferred to separate warranty testing and was felt to be very accurate. We feel the problem of a poor warranty data base and little real emphasis on warranty testing are related since testing helps establish a good data base and develops confidence in the warranty requirements.

Changes in Warranty Laws and Directives

It is common knowledge change takes time to implement. We found this to be especially so in the vast and complicated USAF major weapon system acquisition environment. The systems level warranty law is a major

change from the way the USAF has conducted its business in the past since the new law focuses on the entire weapon system and the USAF has traditionally managed its weapon systems on a component basis. It is very difficult for USAF program management and contracting personnel to efficiently and effectively implement the systems level warranty law when the law changes. As previously mentioned, P.L. 98-212 and P.L. 98-525 were passed within months of each other. The field was only beginning to become familiar with P.L. 98-212 when P.L. 98-525 replaced it. Along with keeping up with changes in the law field personnel had to keep abreast with numerous DOD/USAF implementing directives which changed even more frequently than the law. Adjusting to and understanding all these changes in the law and directives takes time. In addition, many field personnel did not have the knowledge to truly understand the provisions required by the systems level warranty law. The only people we talked to who felt comfortable with the law were lawyers, however; most field personnel who have to implement the law do not have this degree of legal training and knowledge.

We feel trying to adjust to frequent changes in the law also detracts from the field's ability and motivation to effectively implement it. An example of the changes made were first a change in several of the key definitions and second a change in scope of the law. A good example of the importance and impact of the changes was P.L. 98-525 changed the definition of "weapon system," which is the single most important aspect of the law since one must determine if his/her program is a weapon system to see if the warranty law is even applicable. P.L. 98-525 made another important change from P.L. 98-212

by extending warranty application to design and manufacturing requirements into the scope of the law. However it did appear in some cases the DOD/USAF was driving these changes in the law which led to P.L. 98-525. The changes were sought due to difficulties in understanding and complying with P.L. 98-212.

Warranty vs. Other Contract Provisions

Our discussion with a senior USAF legal representative confirmed our suspicions; the systems level warranty requirement conflicts with other standard contract provisions. The basic thrust of P.L. 98-212 and P.L. 98-525 is to limit government liability and risk by placing the burden directly on the prime weapon system contractor. The systems level warranty law requirement is reflected in the special provisions section of the weapon system contract. However in the general provisions section of the contract, the following standard provisions increase government assumption of risk and liability: the inspection clause, the limitation of liability, and the ground and flight risk of loss. The legal representative we discussed this with has worked with several contracts involving the new warranty law and was very knowledgeable. His overall opinion was by writing weapon system contracts with conflicting liability requirements, the USAF appears to be issuing contracts with built in conflicts concerning government versus contractor liability for weapon system defects. This practice puts the Government at risk should they decide to seek a remedy from the contractor under the systems level warranty law. This occurs since the courts have historically ruled against the government (the author of the

contract) in favor of the contractor when the contract is ambiguous.

The same lawyer told us the USAF is now using a Total System Responsibility Clause to help clarify responsibility and liability under the system level warranty law. This clause served to blend warranties between the prime and subcontractors. An example of when this clause would be used is in the case where the prime contractor who manufactures the airframe must mate it with an engine. However the authors find it difficult to understand how this provision will relieve the Government from responsibility from conflicting provisions.

Another senior USAF legal representative informed us the government becomes a self-insurer in "ultrahazardous" situations; this usually occurs where nuclear weapons are involved. The government philosophy in this instance is the contractor cannot assume the risk. Warranties do not usually apply in these ultrahazardous situations.

Model Warranty Clause

DOD is trying to develop a standard or model clause for the systems level warranty that can be used in its contracts. The authors see the overall intent of the model clause as a step to simplify the process of implementing the systems level warranty law. The model clause will provide a point of departure from which a contracting officer can structure a warranty. To date the Office of the Secretary of Defense has developed a model clause for DOD-wide use. To the authors using a model clause for all situations would be difficult due the variety in characteristics of weapon systems. For example some weapon systems,

such as aircraft, are used frequently whereas others, such as missile systems are used only once and normally sits on a shelf until needed. When an aircraft malfunctions it is usually very obvious and if the aircraft is still under warranty it can be repaired by the contractor. However, when a missile fails, it may go undetected for a long period of time, i.e. outside the warranty period. A model clause would need to take into account these kind of differences between weapon systems.

Product Performance Agreement Center (PPAC)

To accomplish the significant task of implementing the systems level warranty law the USAF has established the Product Performance Agreement Center (PPAC) as a specific focal point. PPAC is tasked to assist all buying activities in structuring major weapon system warranties by providing tools (methods to analyze warranties) and guidance. PPAC has also been tasked to provide these same services to the Army and Navy. By way of USAF systems level warranty implementation direction i.e. AFAC 84-10 and DAC 84-9, there is no formal requirement for system program offices, nor anyone else, to consult with PPAC. PPAC does not have enough people or the types of knowledgeable people to prepare system level warranties. In addition, PPAC has a serious problem of turnover among its people; this hurts its ability to provide continuity. We also found many DOD/USAF people were not even aware of PPAC's existence and those who knew about PPAC seldom consulted them. Without exception, the program offices we studied relied on USAF legal counsel to help them with warranties instead of PPAC. Like the rest of the USAF acquisition community, PPAC is learning about the new law.

Major Weapon System Definition

A key factor adding to the uncertainty concerning the implementation of the systems level warranty is an unclear definition of what a weapon system really is. It is obvious to the authors the Congress meant weapon system to include a wide range of DOD/USAF systems. However our interviews indicated a much narrower interpretation was being used by the USAF. Field personnel viewed a weapon system as a system fitting one of the following categories: bomber, fighter, or attack aircraft. This interpretation has the effect of making many key USAF systems, such as the AWACS E-3A, fall outside the definition of weapon system and therefore fall outside the requirements of the new law. We did not see where the DOD/USAF implementing directives such as AFAC 84-10 and DAC 84-9 mentioned specifically where a list of what was and was not a weapon system was maintained or where one would find out such information. There is also some uncertainty whether or not satellite systems are included in the scope of the law. No one seems certain how warranty work on them would be accomplished since they are relatively inaccessible in outer space. The senior USAF legal representative mentioned above noted the use the definition of weapon system under AFAC 84-10/DAC 84-9 now seems to be expanding in scope since such systems as electronic warfare and safety/survival systems are now included. The authors feel the effect of the change in weapon system definition serves to confuse those field personnel charged with implementing the law.

Tailoring Warranties

Under P.L. 98-212 and P.L. 98-525 we did observe tailoring of the system level warranties rather than just inserting the standard warranty and/or correction of deficiency clauses as was previously done under ASPR and DAR. We observed instances of system program offices tailoring warranties for different kind of aircraft, missiles, all-weather/night aircraft fire control and attack systems, and engines. The emphasis P.L. 98-212/525 focuses on specified performance requirements is the main cause of this tailoring. In tailoring provisions to comply with the law the system program offices seemed interested in the following general criteria: a totally useable warranty i.e one that worked, a warranty easy to administer and effective in achieving its purpose, a warranty acceptable to the contractor, and a reliable warranty model for their particular weapon system. None of the programs studied had met all of these criteria but all said a system level warranty would increase cost and administrative complexity.

Warranty Management Procedures

In implementing the new warranty, law the USAF does not appear to have a smooth warranty management procedure between the system program office and the Air Force Plant Representative Office that administers the warranty. In any case there seemed to be confusion in whether or not the ACO at the AFPRO was responsible for warranty administration or if the PCO at the SPO retained that responsibility.

The USAF still is component versus system orientated and still conducts business (for the most part) in this mode. Field personnel do not fully understand how to implement warranties for an entire weapon system. This is particularly true at the Air Logistics Center we studied. By comparison, these same people appeared very comfortable and proficient with structuring and administering warranties for components. As a result, we believe changing to system level warranty management will require a major change in the way the USAF operates its management, control, and accounting systems. The emphasis shifts from components to systems and this requires people to look beyond their particular functional/component area. The system level warranty law also requires a more detailed administration and tracking effort than a component orientated approach.

Warranty Tracking

There appeared to be no way of marking or tracking warranted items on weapon systems at the operation i.e flightline level. From what we could determine, most flightline tracking is done manually and those computer systems that do exist are not suitable for tracking warranted parts. Operational needs often required a malfunctioning aircraft donate its parts to other aircraft to keep them flying. This process is known as cannibalization and does much to complicate the process for developing a serialized control of warranted parts at the operational level. Based on our research, the USAF does not do serialized parts control due to the administrative burden it imposes i.e. many categories of parts and a large number in each category. Part numbers of key

components are maintained for reference but are not part of the daily tracking system per se.

A Warranty as Separate Contract Line Item (CLIN)

We observed no requirement in any USAF contract for the separate control, management, or pricing of a systems level warranty. The system level warranty management and pricing appeared to be "built in" with the overall contract and was not tracked separately.

Our discussion with both USAF contracting officers and senior corporate contracting/pricing people indicated a separate warranty CLIN would be impractical. Though it sounds nice in theory, the difficulties in tracking costs, especially opportunity (intangible) costs, makes a separate warranty CLIN unworkable in practice. Both the USAF and corporate contracting officers felt very strongly opposed to the use of a separate warranty CLIN.

Types of Contracts with Warranties

As part of the implementation of P.L. 98-212/525, the USAF is using system warranties with both firm fixed price (FFP) and fixed price incentive contracts. Fixed price incentive contracts determine warranty costs based on share ratios. The share ratio under the fixed price incentive fee (PPIF) contract has the effect of reducing risk for the contractor until the target cost is reached. On the other hand, FFP contracts put more risk on the contractor with regard to repair/replacement costs.

Sharing of Warranty Knowledge

The sharing of knowledge gained from implementing the systems level warranty law between organizations was little to nonexistent. The benefits of experience do not seem to be passed on. System program offices for the most part seemed to work on their own when it came to structuring and administering the new warranty law. Each program office worked independently from the others and relied heavily on Air Force procurement lawyers. This occurred despite the fact that some programs have gained a good deal of knowledge from working with the new law.

Warranty Implementation Guidance

Despite the formal directives issued we observed little real guidance for field personnel on how to structure or administer a systems level warranty for a new major weapon system. This is especially true with regard to doing cost-benefit analysis. The previous problems discussed in chapter three encountered with the ASPR and DAR warranties do not appear to have been corrected with the FAR and P.L. 98-212/525. Nor did the lessons of the pre-P.L. 98-212 period appear to be learned. As a result the same kind of problems in structuring and administering warranties are occurring as before P.L. 98-212/525.

When we interviewed Government instructors conducting classes in both the introductory and advanced contract administration, we found warranties were only mentioned on a superficial level. The basic class had an hour of instruction on warranty administration and did not

discuss P.L. 98-212/525. The advanced classes were conducted in a seminar format and discussed warranties only if the students raised the issue. We did not see any type of warranty handbook to help the students conduct essential functions, such as a warranty cost benefit analysis, administration, tracking, and the like. As it stands now there is currently no dedicated systems level warranty training class for the USAF nor do there appear to be plans to develop one.

P.L. 98-212/525 vs. The Competition in Contracting Act (CICA)

Many of the USAF contracting people interviewed felt there was or would soon be a conflict between P.L. 98-212/525 and the Competition In Contracting Act (CICA). They felt P.L. 98-212/525 was pushing the contractor toward doing more work inhouse thus avoiding dependence on subcontractors, thereby reducing competition. For the present contractors are going with the status quo i.e. component breakout. An adverse court ruling could change all this since the prime contractors will do more work inhouse to avoid the risks associated with their warranting of subcontractor equipment. This conflicts since CICA is encouraging more competition, increased number of sources, and component breakout.

Contractor Reaction

The contractor community without exception felt customer goodwill was extremely important. In that regard if the customer, i.e. government, wanted a warranty then they were willing to give them one.

The emphasis on goodwill seemed especially important where contractors were in competition against each other. Many of the contractors went beyond the terms of a normal warranty just to maintain goodwill. Contractors seemed willing to absorb many little costs for the sake of goodwill. Their only reservation about warranties was in the event of a catastrophic loss or failure where they felt the company might be unable to compensate the Government. Contractors realize the current political climate views them negatively; hence their support of warranties. Most contractors felt making defense products e.g. aircraft was their primary business and they felt worrying about warranties (i.e. being in the insurance business) detracted from their primary mission.

Warranties and Engineering Change Proposals

An engineering change proposal (ECP) is the formal vehicle used to change the weapon system design baseline. ECPs are used to update the weapon system to meet a changing threat and/or insure safety of flight. However we found out when the Government issues too many ECPs, this frustrates the use of a systems level warranty since the technical/design baseline is in a constant state of flux. It really is not fair to hold the contractor accountable for a weapon system warranty when so many changes are being made by the Government which impact the warranty.

Chapter Summary

In this chapter we examined USAF implementation practices and administration of the systems level warranty law.

Since a law and/or regulation is only as good as its enforcement, the authors obtained data on how field personnel were actually implementing the systems level warranty. Accordingly the chapter discussed the results of our nonattribution interviews.

Key findings regarding field implementation were: no one really knew how to do a cost-benefit analysis; a useable warranty data base from which to price warranties was not being developed; there was little emphasis on warranty testing; frequent changes in the systems level warranty law and implementing directives made it very difficult to implement the law/regulations; the definition of weapon system was unclear; frequent issuing of ECPs frustrated warranty use; P.L. 96-212/525 appeared to conflict with CICA/component breakout philosophies; and major weapon system contracts were being written with built in conflicts i.e. standard provisions conflicting with special provisions concerning warranties. We also saw little sharing of knowledge i.e. those programs having experience with the systems level warranty law did not seem to pass it on to others who needed it. Each program office seemed to be on its own in this regard. As for tracking, we observed no separate warranty contract line items, we found no smooth warranty management procedures between key players, and there appeared to be no meaningful way to track warranted items at the flightline

level. With regard to correcting these problems, we saw a model clause was in work (though it is not finished) and the USAF has established a special office, PPAC, to help field activities with warranty problems. An encouraging sign was tailoring of the systems level warranty requirement in some major aircraft and missile system programs rather than just inserting a standard clause as was previously done under ASPR and DAR. Most contractors are interested in doing a good job for the USAF and will even go beyond the warranty in many cases. Contractors have some reservations about the practicality of the law, especially with separate warranty contract line items but realize the type of political climate the warranty law was born in and as a result they are are hesitant to criticize it.

We wish to note some final points before our conclusion. First the systems level warranty law to date has not been tested in court. Both the USAF and contractors are trying to understand the new law. There was a consensus of feeling among USAF and contractor personnel that the Government had more remedies under the old correction of deficiency clause since the new law only addresses contractually specified essential performance requirements whereas the COD was all encompassing. Finally the authors felt USAF and contractor personnel took pride in their work and wanted to get the best product at the best price regardless of whether or not there was a warranty clause.

VII. CONCLUSIONS AND RECOMMENDATIONS

Overview of Chapter

In this chapter we discuss our conclusions and projections regarding the system level warranty law and its effectiveness in improving the quality of major USAF weapon system acquisitions. Other major topic areas include a discussion of alternatives surrounding the systems level warranty law to include general comments on the issue. The last section of the chapter discusses our recommendations. Also discussed are our recommendations for future research.

The authors conclusions and recommendations concern broad management issues and do not discuss the detailed i.e. technical aspects of warranty implementation. Our conclusions and recommendations are based on both our literature review and field research. The opinions in this chapter are the authors' and not official DOD, USAF, AFSC or any other agencies policy.

Conclusions/Projections

Our overall conclusion is the systems level warranty law will not substantially improve the quality of major USAF weapon system acquisitions given a continuation of the current situation. Specific problems impeding the progress of the systems level warranty law are:

- a. The USAF still manages its major weapon systems from a component

as opposed to a overall system perspective. Managing weapons from a component perspective is in fundamental conflict with the philosophy of the systems level warranty law. The management and control mechanisms for component versus system management are different because the former requires a higher degree of integration, coordination, cost, and detailed tracking/accounting. The USAF is set up for managing components and to establish the extra control mechanisms required for systems level warranties would involve a significant structural change to the way the USAF conducts its acquisitions and support business. More important, changing from a component to system orientation would involve a major change in the basic USAF weapon system management philosophy since people would be required to look beyond their particular component and/or functional area. The consequences of the current situation are the USAF will have difficulties in identifying defects and proving contractor liability.

b. The systems level warranty law cannot be efficiently or effectively implemented if a cost benefit analysis cannot be performed. The USAF does not have a structured and quantifiable way to analyze warranty cost and benefits and thus has no way of knowing if a warranty is beneficial. If no one can do a warranty cost benefit analysis we do not see how the law can be realistically complied with.

c. A related area to cost benefit analysis is the warranty data base. As explained in chapter six the USAF is not developing/maintaining an adequate data base from which to perform warranty cost-benefit analysis. Without a complete and integrated data base there is no meaningful way for the USAF to perform cost-benefit

analysis or any other type of realistic warranty tradeoff analysis. The current reliability and maintainability data base is not geared toward warranties; however; given its limitations it is best used for component warranties as opposed to system warranties. Effective implementation of the law requires a strong warranty data base. Since the current system is not developing this data (nor are there plans to do so) effective implementation is not possible. In addition, the current system is not providing feedback to buying offices concerning the effectiveness of warranties currently being written. This feedback is necessary to maintain an effective and updated management of system level warranties and insure warranties are updated over time and thereby avoid duplicating mistakes or writing poor warranty provisions.

d. The lack of a sound warranty testing program with clear objectives impacts the effective implementation of the law. Warranty testing is an important part of building this data base because it is used for cost benefit analysis. We found no evidence the USAF will effectively be able to implement the warranty law unless it requires more specific testing for warranty purposes.

e. Frequent changes to systems level warranty laws by Congress and equally frequent DOD/USAF changes to implementing directives have the effect of confusing, frustrating, and destroying any individual initiatives field personnel might have. We do not see how the law can be effectively administered if field personnel are not sure what is expected of them.

f. The law cannot be effective if the USAF is issuing contracts with built-in conflicts. In some contracts the special provisions section requires system level warranties yet the general provisions section through other clauses limits contractor liability and reduces and/or even negates the effectivity of the warranty law. Case law has demonstrated the author (in this case the USAF) of ambiguous contract provisions is usually ruled against and the less stringent of the two provisions is enforced.

g. The authors feel a law is only as good as its enforcement and do not see how P.L. 98-212/525 can be effectively enforced in major USAF weapon system acquisitions when the office charged with implementing the law, PPAC, is effectively powerless. The USAF gave PPAC an awesome responsibility but not the commensurate authority. PPAC has been handicapped because: it has a very serious credibility problem among the system program offices; PPAC has a steady and rapid personnel turnover; and PPAC is not a required stop in such key implementing directives as AFAC 84-10 and DAC 84-9. Being assigned below a major command level, PPAC has lost a great deal of authority when trying to enforce a USAF wide program. PPAC has suffered from a lack of clear goals/objectives for both the short and long term. The combination of the above factors work to hinder PPAC's effectiveness. There is a need for an integrated approach to implementing the systems level warranty law for the USAF. Without PPAC, or similar agency performing this task, the USAF effort becomes fragmented and piecemeal. PPAC's inability to perform severely limits the effectiveness of the law.

h. The determination of what is and is not a major weapon system is a key factor in determining whether the warranty law applies. We do not see, given the confusion of what a major weapon system is, how the USAF can effectively implement the law when it is not even sure what systems it applies to.

i. Confused warranty management procedures between the principal players in the acquisition process is a key problem hindering the effectiveness of the systems level warranty law. The warranty law cannot be effective if for example the PCO and ACO do not know their respective roles in such vital areas as warranty administration and implementation.

j. The USAF currently does not have a method to effectively track items which comprise individual weapon systems in a manner which will insure the effectiveness of the systems level warranty law. Tracking is currently done by component and not by system. That is, the tracking which is performed is not accomplished by tracking each and every item in a system but individual components. When a component is removed from a system it loses its identity with the particular weapon system it was removed from. In addition the component tracking, which is currently being performed and for which warranty data is being gathered, is not being consolidated and used for pricing future warranties. There is a scarcity of warranty data on which to base any kind of tracking/pricing.

k. Our research indicates a lack of knowledge sharing among the various program offices and this means the same mistakes will probably be repeated again and again. Without a sharing of knowledge and/or

experience on the systems level warranty law, the USAF will realize only limited benefits with their use. Field personnel are currently operating on their own when it comes to structuring/implementing a systems level warranty. Without a sharing of knowledge the USAF is missing an opportunity to spread the benefits of its successes to all programs.

1. P.L. 98-212/525 is pushing contractors to do more work inhouse while CICA seeks to enlarge the business base. Congress felt strongly enough about weapon system quality to pass P.L. 98-212/525. In a similar manner Congress felt the Competition in Contracting Act (CICA) was needed. However, if the laws conflict with each other how can either one be effective if they are working at cross purposes?

u. The authors feel the warranty law will work best if a stable design exists. However when the USAF makes changes in the form of engineering change proposals (ECPs) to a particular weapon system baseline (used for the warranty) and still tries to make the contractor responsible for warranting the system, a fundamental question of fairness arises and whether or not this will stand the test of court law. In our opinion the use of a stable design/technical baseline, e.g. jet engines, is imperative to the use of a warranty. A baseline in a constant state of flux should not be warranted as it is unfair to the contractor. Trying to hold contractors responsible for warranting a constantly changing baseline is unwise and unfair.

o. Finally our research revealed a low level of warranty knowledge and motivation among government employees. We believe this is partly

due to the low level of training.

Given the above reasons the authors do not believe the systems level warranty law, despite the best intentions, will achieve its desired goal of substantially improving major USAF weapon system quality. The essential problem limiting the possible success of the system level warranty law is the lack of the necessary USAF acquisition/logistics infrastructure required to support it. Component management and control systems continue to be predominant in the USAF.

Despite drawbacks the law has not been without its benefits. The law increased emphasis on weapon system quality and reliability/maintainability. The law has made some programs rethink their standard approach to warranty use (i.e a verbatim insertion of the COD clause from one contract to the next) where the USAF is starting to tailor warranties to individual systems. We feel PPAC, despite some drawbacks, was a good start toward effective implementation of the law.

If the USAF acquisition community does not address the above concerns, then future problems will occur. The major problem we see is the possibility of future charges of waste on USAF use of system level warranties and embarrassing court cases where the USAF will be unable to prove the prime is responsible for weapon system failures. Since the USAF does not have a good warranty data base or way to cost analyze warranties, future critics may allege the USAF paid too much for its warranties. Furthermore, critics may argue the USAF did not work to update its warranties for follow-on buys of the same or similar weapon

system. These could be a serious problems for the USAF since a public perception of poor management could be created and/or reinforced. A poor public perception could lead to the enactment of more legislated "reforms" which effectively denies the USAF a chance to work out its own problems.

Given the above situation the authors believe it is necessary to discuss alternatives that may correct the above problems.

Alternatives

Our discussion of possible alternatives concerns ways to improve the quality of major USA weapon system acquisitions. We will discuss five proposed alternative scenarios and then present our recommendations.

Alternative 1. Increase the Role and Scope of PPAC.

Before discussing this alternative in detail, the reader should note our remarks are only applicable to the USAF aspect of PPAC. The basic thrust of this alternative is to give PPAC increased authority, increased visibility and a dedicated staff. PPAC would be the true focal point for USAF implementation of the systems level warranty law by formal direction. Upfront warranty planning would be required in such documents as the program management and acquisition plans using PPAC'S expertise.

PPAC's staff would be expanded to include all key acquisition related disciplines to include: contract writing, buying, contract

administration e.g. HQ AFCMD and AFRPOs, logistics, legal, contract termination, as well as user input. These personnel would be assigned to PPAC on a permanent basis; the current practice of using "loaners" would be discontinued.

To avoid any confusion about whom PPAC works for, the office should be established under AFSC. The authors feel systems level warranty planning must occur early on and AFSC is best suited to do this given its early involvement in the acquisition process. AFLC was felt to be involved too late for the benefits of PPAC to be effectively realized. However the appropriate AFLC offices should work with PPAC early on to insure an effective warranty administration and implementation effort. The PPAC office would be equally accessible to all major AFSC product divisions to include: Aeronautical Systems Division, Electronics Systems Division, Space Division, Armament Division, and the Ballistic Missile Office. Each would use PPAC as an advisory resource to help with structuring/implementing its warranties.

Alternative II. Repeal P.L. 98-525 and return to use of the correction of deficiencies clause.

In our opinion the COD provision under the ASPR and DAR were basically workable given their catch all nature and when a state of goodwill existed between the USAF and contractor. However the COD clause was really only effective for components and not for weapon systems. If the COD were reinstated for use as an alternative to P.L. 98-212/525, then it would need to be modified. The new COD clause would need stricter requirements concerning the burden of proof for defects

and a change in its scope to include weapon systems. Without these changes the value of the warranty (under the new COD) would be reduced. The authors do not feel the repeal of P.L. 98-525 is likely to occur given the current political climate and perceptions the DOD/USAF is not managing its major weapon system acquisition programs efficiently and/or effectively.

Alternative III. Make reliability and maintainability a direct contract incentive instead of using warranties.

In this situation direct incentives would be given to contractors who achieve stated reliability and maintainability (R&M) goals. The theory in this case is warranties are an indirect R&M incentive whereas direct R&M incentives are better since they target key areas and probably are less expensive than a system level warranty. At first this seems like a good idea; however, a closer examination yields problems. For instance what type of incentives could be effectively used to improve R&M since it has been proven cash incentives (the traditional approach) do not always work as expected. Another difficulty with implementing this approach is the USAF may unintentionally target the wrong R&M areas whereas a weapon system warranty would provide a more general coverage. Lastly, contractors may find a way to circumvent the intent of the R&M incentives. This puts the quality of our weapon systems at risk. Overall we did not feel this was a viable alternative to the systems level warranty law. However, R&M incentives may help in a limited number of cases. Their use should be well thought out.

Alternative IV. Abolish PPAC and let each program office implement its own weapon system warranties.

In this situation, PPAC would be abolished and each program office would be responsible for its own implementation of the systems level warranty law. Each program would be allowed to use its expertise to tailor an effective warranty. This approach is not without problems. First of all there would be a duplication of effort and resources. Another problem would be the lack of an integrated warranty data base. Finally there would be little sharing of warranty knowledge and/or experience as is now the case.

Alternative V. Let the USAF assume the role of total self-insurer for its weapon systems.

In this situation the USAF would assume total responsibility for its weapon system from the outset. The USAF would be a self-insurer for its major weapon systems. Implicit in this discussion is a reliance on contractor goodwill and adequate competition to insure high weapon system quality. As previously mentioned, contractors will go to great lengths to maintain customer goodwill. Competition provides incentives for contractors to lower costs and improve quality. In many cases even beyond what a warranty requires. This is especially true in the case of the Lockheed C-5B versus the McDonnell-Douglas C-17 and the Northrop F-20 versus the General Dynamics F-16. Given this situation, greater savings may be realized through reliance on goodwill and competition. Being a self-insurer would lower costs to the USAF; however, the risk to the USAF would increase if defects did occur. USAF transition to the

self-insurer role would not occur at an exact point. Rather the USAF assumption of the self-insurer role would occur in a gradual and phased manner. As the weapon system matured, the design stabilized, and the R&M/warranty data base became available, the USAF would gradually assume more risk. This would allow for a cost-effective transition of risk from the contractor to the USAF.

General Comments

Before providing our recommendations, the authors feel it is appropriate to discuss some general issues surrounding the systems level warranty law. Our discussion is intended to provide the reader a better insight into why we chose our particular recommendations.

First of all, the authors agree warranties are a good thing. Warranties can be effective if the people charged to implement and administer them are properly trained in their use and are willing to enforce them. Like all other contracting practices, warranty use must be fair and reasonable to both the USAF and the contractor. For a warranty provision to be fair to the prime contractor, there must be a fair and reasonable allocation of risk between the prime and his/her subcontractors. Putting all the risk on the prime may be unfair considering the circumstances.

To date, the systems level warranty law has not been tested in court. However the authors feel if a case should arise, then there would be problems with finger pointing between contractors. We do not feel it is fair to hold the prime contractor responsible for all the

actions/inactions of his/her subcontractors e.g. fraud. If the USAF cannot monitor its systems level warranties inhouse then how can it honestly expect contractors to do so? To be fair, the prime contractor should be compensated to monitor warranties for his/her subcontractors. If the prime does not have the responsibility for warranty monitoring of subcontractors, then the system becomes a paper tiger with neither the prime nor USAF controlling it. Our overall opinion in this area is if the prime is to be held accountable for warranting other subcontractors work, then this will force the prime to do more work inhouse. Since the law has not been tested, prime contractors are going with the status quo i.e. component breakout and other DOD competitive initiatives; however; an adverse court ruling could quickly change this practice. The result would be a major conflict between P.L. 98-525 and CICA.

We feel the working level people should be given more of a say in whether a warranty is applicable or not. We do not see why a warranty has to be approved at such a high level i.e. at the Congressional and Secretary of Defense level. Such high approval levels for what should be routine program office decisions run contrary to the initiatives of the acquisition improvement program (AIP). The AIP is trying to bring decision making to the lowest possible level, whereas P.L. 98-212/525 contradicts this. The people in the field usually understand the situation better than anyone else. It does not make sense to bypass them when a decision is required regarding warranties. Yet the law and implementing directives effectively take the warranty decision out of their hands. Jacques S. Gansler, a noted authority on the DOD weapon system acquisition process, makes the following applicable comments on

decision making-levels in the July 85 issue of Air Force magazine:

Overall, there are two dominant considerations in corporate planning and control: first, a focus on centralized decision-making and decentralized implementation and, second, on tying planning and execution together by holding line managers responsible for both creating and implementing the plan, rather than separating planning and execution.

By contrast, with the defense establishment, we find almost the reverse of these two principles. First, the emphasis, even in the current Administration, is on decentralized decision-making and highly centralized control over the details of implementation. It's not only backwards, but it's wrong from both the decision-making and the implementation perspectives. Second, planning is almost totally divorced from implementation. Those who are responsible and who have the authority to implement a plan have no hand in its creation. (31:96-97)

We are encouraged to see warranty decision-making authority (e.g. waivers) now being further delegated to the Major Command level; however, this level is still too high. We realize Congress has established such high approval levels because they perceive weapon system programs are not being well managed. Micromanagement is not the answer. Congress and the USAF need to work as a team and not as adversaries. To help correct this situation, we believe the USAF should take much more positive steps to advertise its successes rather than letting people dwell on the minority of programs that fail. Gansler provides a good insight in this regard.

One very important fact, frequently overlooked by defense critics, deserves mention here - namely, that DOD has repeatedly been shown to be the best managed of all government agencies when measured by such criteria as cost overruns, performance achievements, etc. Nevertheless, there is clearly room for improvement. (31:95)

Getting an improved acquisition system is no accident. Before meaningful improvement occur, there must be a careful analysis of the situation. In this case, there should have been a careful study of the effects of the systems level warranty law before it was passed. We commend Senator Andrews and his staff for their concern about declining weapon system quality. It is necessary and proper Congress insure the monies it appropriates are being used effectively. We feel it is equally necessary to study the effect a new law will have. In this case there was adequate documentation to show the USAF had warranty implementation and administration problems that would not be cured simply the passing of a law. The USAF acquisition and logistics infrastructure was not set up for a systems level warranty but rather for components.

We do not feel it is inherently fair to compare a tractor to a major weapon system, as Senator Andrews does. The two are quite different. Major weapon systems are usually more complicated and may involve state-of-the-art technology, the specifications are controlled by the Government and not by the contractor, and weapon systems usually operate in more hostile/demanding environments than commercial items. Analogies are an important way of helping people understand complex issues. However, the analogies must be reasonable. The analogy used that compares space shuttle equipment being warranted and weapon system warranties was much more appropriate. The public also needs to realize the same type of aircraft, only with a different model number, can be substantially different. For example the different versions of the Lockheed C-130 e.g. the C-130E, DC-130, HC-130, etc. are essential

different aircraft inside, though the outside configurations are similar. The same can be said of the differences between the F-16 A/B model and the F-16 C/D model. The latter models represent a major increase in capability over the first two models even though their external configurations are similar. The type of model can also influence other type of systems. For example the Maverick, AGM-65 air-to-surface missile, has a TV guided version for the A and B model and an infrared version in the D model. To be fair, analogies used for weapon systems must take into account these differences between models of the same aircraft or system.

The last item in our general discussion concerns the strengths and weakness of our thesis. The nonattribution aspect made little difference in several cases. Several key executives said they would have the same opinion in any case. The nonattribution policy proved most useful where contractors were involved and permitted us to discuss sensitive issues impacting the law. We realize the inability to cite specific sources weakens the credibility of this thesis. However, we feel the level of understanding gained from these face-to-face field interviews offsets this. Our overall opinion was the field interviews were absolutely essential to determining what was really occurring with the new law. We found the published literature only really focused on analyzing the law rather than field practices; we feel our thesis overcomes this shortcoming and is an effective blend of the literature review and field surveys. Our literature review found many people criticizing the problems of poor weapon system quality and of the systems level warranty law. We did not find much being said on how to remedy

the situation. Accordingly we will present our recommendations for improvement rather than just level criticism.

Key Recommendations

In this section we discuss the recommendation selected from the previous alternatives. We will also discuss recommendations for follow-on research.

To be effective, our recommendation must be worthwhile, easy to understand i.e. uncomplicated, and able to be implemented efficiently and effectively. We also recognized the need to be creative and flexible. Accordingly our recommendation for effectively implementing the systems level warranty law calls for a combination of alternatives one and five. Alternatives two, three, and four were not selected since we did not think the law would be repealed or circumvented nor do we think the USAF should abolish PPAC.

Our specific recommendation combines alternatives one and five. The systems level warranty law can be a valuable tool to the USAF if implemented effectively. We see PPAC as being the key element in the effective USAF implementation of the law. Establishing PPAC was a good start but more must be done. PPAC has four key needs at this stage. First of all, PPAC needs to recruit and retain quality people from a variety of acquisition related disciplines e.g. contracting, program management, legal users, and the like. Second, PPAC needs formal recognition in USAF warranty implementing directives such as the Defense

and Air Force Acquisition Circulars as well as the DOD FAR Supplement. Third, PPAC needs a higher organizational position than it currently has. PPAC should be elevated to a higher level within AFSC where it is equally accessible to all the product divisions and not just ASD; although we recognize the majority of USAF weapon system acquisition dollars are spent at ASD. Fourth, PPAC needs resources to establish a warranty data base as soon as possible.

We see PPAC needing to expand its role to meet its charter. First, PPAC should be the true warranty integrator (using an interdisciplinary approach) for the USAF. PPAC must assume a more active role in helping the various program offices structure and implement system level warranties. In the same light, PPAC must help these same program offices establish realistic warranty objectives and achieve a cost-effective tailored system warranty. PPAC should take the lead in developing quantitative tools to analyze warranty benefits i.e. cost-benefit and warranty life cycle cost analyses. These quantitative models should be computer based to allow managers to quickly perform "what if" analyses. Given a multitude of essential performance requirements to choose from, PPAC should help the program offices decide which are the best ones. PPAC's most important role should be to act as a catalyst to change the USAF acquisition and logistics infrastructure from a component orientation to a system orientation. We realize this will not be an easy goal. Good warranty implementation planning for both the short and long term is a good start toward achieving this goal.

The second half of our recommendation comes from the fifth alternative which says the USAF should gradually assume the role of

self-insurer as the weapon system matures. The USAF should use a quantitative decision model, preferably computer based, to help decide the degree and times for self-insurance. The model should provide updated warranty costs as a system matures as well as flexibility to perform "what if" analyses on warranty cost sharing ratios. The model should also be able to determine specific warranty period durations since it is usually advantageous to the USAF if weapon system/component warranty periods coincide with each other. An important aspect of this recommendation is competition. Competition is a key element which helps insure contractors provide effective warranties. In the competitive environment contractors, in an effort to win the contract award, provide warranties which are more beneficial to the USAF in an effort to win the competition. In the same manner, competition allows the USAF to get a better price on warranties, better product quality, and more contractor innovation.

Other Recommendations

Besides the above recommendations there are other ways to improve systems level warranty implementation in the USAF. Our first recommendation is to stress early warranty planning among the key players in AFSC and AFLC. Warranty performance and cost data should be collected and analyzed as soon as possible. For new weapon systems, warranty related data should be collected not only during production but also during full scale development. The authors note that collection of warranty data need not be on a grandiose scale to be effective. Since warranties are only as good as their administration, the USAF should

establish formal training beyond the current level (explained in chapter 6) in warranty administration. Like many other aspects of weapon system purchases, the government can achieve economies for warranty costs by considering large quantity buys i.e. multiyear procurements of its weapon systems. By doing so the warranty costs can be spread over a large number of units and this saves money. The USAF and Congress need to work as a team. When new legislation is proposed, its effects should be studied upfront. The USAF should publicize its success more often to help promote a positive public image.

Recommendations for Follow-On Research

The systems level warranty law involves many issues. The scope of our thesis did not permit us to investigate them all. However we feel the following are excellent research topics. PPAC could seek the assistance of the Air Force Institute of Technology's (AFIT) graduate students in researching these topics:

- a. A longitudinal study of the effects of the systems level warranty law on the quality of major USAF weapon system acquisitions.
- b. A method to perform a cost-benefit analysis on weapon system warranties. Preferably this model would be computer based and able to be easily learned and used by managers.
- c. A method of establishing an integrated and centralized warranty data base.
- d. A study on what a warranty training program should include e.g. types of learning objectives.

e. A study of the effects of the systems level warranty law has on CICA, component breakout, and GFP. The reverse relation should also be studied.

f. A study on the emergency/wartime aspects of the systems level warranty law. The concern is the weapon system level warranty law may cause the USAF to gear its maintenance infrastructure to suit a peacetime situation where defective systems are sent back to the prime contractor's plant for repair. This could leave the USAF short of organic capability at its operating locations in case of an emergency or war.

g. A study on the impact of concurrency and warranty use. An example of this would be the case when the USAF is buying the second production run of a system e.g. engines; however, the first engine (from the first production run) has not been received. The essential question is how do you update a warranty with respect to cost and performance under these circumstances.

h. A study of the legal ramifications concerning warranty liability in the case where the USAF (through the systems program office) acts as the weapon system integrator instead of a prime contractor.

Chapter Summary

Our overall conclusion for this thesis was the systems level warranty law will not substantially improve the quality of major USAF weapon system acquisitions given a continuation of the current situation. This occurs since the USAF does not have the necessary acquisition and logistics infrastructure or management philosophy to

support system level warranties.

Our general comments covered a wide variety of topics. First, we believe warranties are a good contract tool when effectively applied. Warranty use must be fair and reasonable in all cases. Second, we believe the decision making level for warranties was too high and should be made at a lower level. Third, we believe a team approach between the Congress and USAF is needed. The USAF needs to actively publicize its successes to help it foster a positive public image. Fourth, we discussed the limits of our study. We noted the nonattribution method allowed us, in some cases, to get information from contractors that would not normally be provided and we recognize the inability to cite specific sources weakened our thesis but believe this is more than offset by the knowledge gained from the field interviews. The strength of our thesis comes from the field interviews since the published literature only provides analyses on the law and not actual field practices. Any meaningful study must consider and evaluate actual field administration practices.

Our specific recommendation called for a strengthening of PPAC and a gradual assumption (transition) as a self-insurer by the USAF as the weapon system matures and confidence is improved since you now have more R&M data. We recognized our study is not all-encompassing. Accordingly we highlighted areas for future research.

Our confidence of the findings in this research have been supported by a recent report found in The Government Contractor Briefing Papers dated July 1985. This report strongly validates our research

findings and recommendations.

The Congress and the USAF are charged with a common duty to protect the welfare and freedom of the United States. An essential part of this duty is to insure we have a strong and credible military deterrent. The U.S. military deterrent is severely degraded if its weapon systems are of poor quality. Poor quality weapons endanger our freedom and the lives of military members in combat. This situation should not and cannot continue. Senator Andrews is absolutely correct to insist on quality. He would be remiss not to. Our feeling is the quality of weapon systems can best be improved in the Congress, USAF, and prime contractors act and work as a team. After all who wants weapon systems to work more than the people whose lives depend on them and those people who provide them. The tendency has been to assume adversarial relationships and this hurts all parties involved since the spirit as well as the benefits of teamwork are defeated. This is no more apparent than in this case where the Congress passed a law which requires the services to accomplish its directives when their implementing systems are not effectively able to support it i.e. the USAF component management approach. We need to restore this team spirit if we are to truly improve the quality of our weapon systems and remain a powerful force in preserving our freedom as our founding fathers intended.

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Captain Richard J. Hernandez was born 21 December 1957 in Elmhurst, Illinois. He graduated from high school in Washington, D.C. in 1976 and attended the U.S. Air Force Academy where he received the degree of Bachelor of Science in Management in 1980. Upon graduation he received a regular USAF commission. He served as an aircraft modification project manager in the 4950th Test Wing at Wright-Patterson AFB, Ohio during which time he received the Air Force Commendation medal. He briefly served as a program manager in the Maverick missile system program office until he entered the School of Systems and Logistics, Air Force Institute of Technology, in May 1984.

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The issue of poor weapon system quality has recently received much media and Congressional attention. Part of the reaction to the problem of poor quality with some systems was the enactment of Public Laws (P.L. 98-212 and P.L. 98-525) requiring warranties for DOD weapon systems. This thesis examined whether or not system level warranty laws would improve the quality of major USAF weapon system acquisitions.

To keep the scope manageable, the authors focused only on major USAF weapon systems with a total acquisition value over \$1 billion that were in full scale production and were under a fixed price type contract. Our basic research consisted of a literature review to gather data on warranties under the old and new laws and then to compare field practices under the old and new warranty laws. To get information on prior and current field practices we interviewed middle and top managers.

After conducting our research and analyzing our data the authors arrived at the major conclusion: the system level warranty law will not substantially improve the quality of major USAF weapon system acquisitions since the USAF acquisition and logistics infrastructure is geared to components and not systems. Other factors impeding the effective implementation of the law are: a poor warranty data base, no real structured way to perform warranty cost-benefit analyses, unclear definition of weapon system, and the lack of effectiveness of the USAF warranty focal point i.e. the Product Performance Agreement Center (PPAC).

Our major recommendation is the USAF should give PPAC the necessary authority and resources to carry out its assigned mission of helping the USAF acquisition community with warranties. The USAF should also develop qualitative and quantitative warranty decision models to help analyze warranty cost-effectiveness and field personnel should be trained in their use.